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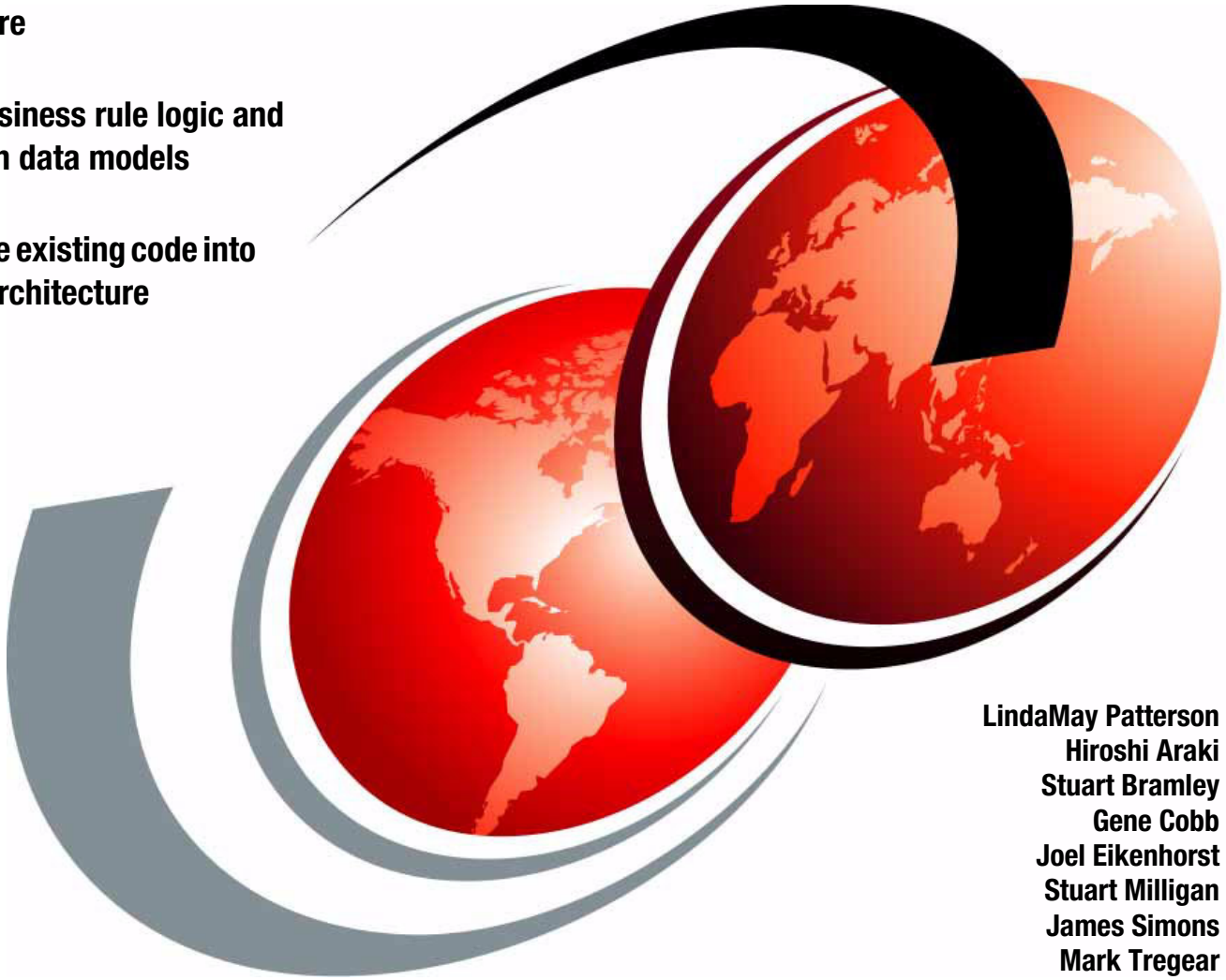
Modernizing and Improving the Maintainability of RPG Applications Using X-Analysis Version 5.6

- Graphically analyze application architecture
- Extract business rule logic and application data models
- Modularize existing code into the MVC architecture



LindaMay Patterson
Hiroshi Araki
Stuart Bramley
Gene Cobb
Joel Eikenhorst
Stuart Milligan
James Simons
Mark Tregear

Redpaper

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International Technical Support Organization

Modernizing And Improving the Maintainability of RPG Applications using X-Analysis Version 5.6

February 2006

Note: Before using this information and the product it supports, read the information in “Notices” on page vii.

First Edition (February 2006)

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Preface

This IBM® Redpaper covers the use of X-Analysis from Databorough Ltd. to accelerate the modernization and improve the maintainability of existing RPG applications. This paper shows how X-Analysis creates a cross-reference repository, data model, and process model from an existing RPG application. These artifacts can be viewed graphically using the X-Analysis client running on a personal computer. This paper shows how to use the X-Analysis client to explore the application visually, starting from a high-level model and drilling down to program details, such as the specific use of fields and files. In this paper, you will find step-by-step examples and scenarios showing an RPG application exposed by the tool and being modernized in various ways.

This paper is primarily intended for Information Technology (IT) architects and developers charged with modernizing and maintaining existing RPG applications. IT executives will also gain knowledge on managing and evolving their existing applications.

The paper shows you how to use X-Analysis to convert an existing application to the Model-View-Controller architecture. In this instance, the View and Controller portions of the application are converted to JavaServer™ Faces and JavaBeans™. X-Analysis takes advantage of the implicit data and process model in the application to create individually callable pieces of business logic.

This paper explores many of the capabilities available in X-Analysis and shows you how to write programs to use information stored in the cross-reference repository. You can use this information to simplify and automate your conversion process.

The paper focuses on three key business scenarios:

- Business Scenario 1: A software company is facing competitive pressure to provide a browser-based and a rich-client interface to their product. The product is currently written mostly in Original Program Model (OPM) RPG with some programs written in Integrated Language Environment® (ILE) RPG. The company has decided that the existing application must be changed radically. They intend to keep the business logic in RPG but want to transform the entire presentation and control layer to the Model-View-Controller (MVC) architecture.

  For this scenario, the paper shows how X-Analysis is used to re-engineer a portion of the sample application using Java™ and the MVC architecture.

- Business Scenario 2: This company develops and maintains their OPM and ILE RPG applications in-house. Over time their applications have become unwieldy and unmanageable. The company's biggest concern is the amount to time it takes to respond to requests for additional function. They must deal with the maintenance issues and find a new approach to handling enhancements. However, re-architecting the applications and using new technology such as Java is not an option.

  For this scenario, the paper shows how X-Analysis can be used to improve the maintainability of applications while minimizing the effect of changes to the business environment.

- Business Scenario 3: This company has a highly skilled staff of RPG and Java developers who are doing iSeries™ and Web development. Many of their applications were developed in an ad hoc manner, creating a situation where the company is dependant on hard-to-maintain applications. The strategy is to develop future applications using Java where possible, componentize the RPG, or port the RPG to Java (if that approach is more

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cost effective). The company understands that the big bang theory of application modernization is far too risky, so they want to use an incremental approach.

For this scenario, the paper shows how X-Analysis empowers the development team by isolating application segments, allowing them to understand and explore the programs, display files, and data files involved (in that segment). This knowledge aids the team in modernizing the segment without disrupting the overall application.

This Redpaper also presents the details of the X-Analysis cross-reference repository and shows you a program that accesses the information in the repository.

The team that wrote this Redpaper

This Redpaper was produced by a team of specialists from around the world working at the International Technical Support Organization, Rochester Center.

Lindamay Patterson is an Advisory Software Engineer in the International Technical Support Organization, Rochester Center. She leads teams that produce iSeries and IBM software related presentations, Web content, and Redbooks™. Before joining the ITSO, she worked on various Redbooks about Pervasive (Mobile) Computing and has had numerous articles published.

Hiroshi Araki is a Software Engineer with Japan Business Computer Corporation (JBCC) and is located in Japan. He has 17 years of experience working on the AS/400® and iSeries platforms. His areas of expertise include application development tools, high availability software support, and iSeries technical support for customers.

Stuart Bramley is a Technical Architect at Skandia, in England. He has nine years of application development experience with the iSeries platform. He holds a degree from Keele University, England. He is an IBM-certified RPG developer and a Sun™-certified Java programmer. Currently, he is involved in a major modernization project at Skandia.

Gene Cobb is a DB2® UDB Technology Specialist in eServer™ Solutions Enablement. He has worked on IBM midrange systems since 1988, with 10 years in the IBM Client Technology Center (CTC), IBM Rochester. While in the CTC, he assisted customers with application design and development using RPG, DB2 UDB for iSeries, CallPath/400, and Lotus® Domino. His current responsibilities include providing consulting services to iSeries developers, with special emphasis in application and database modernization.

Joel Eikenhorst is a Senior Software Engineer with the Client Technology Center in IBM Rochester, Minnesota. He has 28 years of experience in various areas of the Rochester Lab including: Data Communications, Client/Server Technologies, VMC-SLIC, Database, Performance Analysis, and Java. His current interests include program modernization, development tools, and rich client technologies. He holds an M.S. degree in Computer Science from the University of Nebraska.

Stuart Milligan is the Technical Marketing Manager at Databorough and is responsible for the technical design and development of X-Analysis modernization extensions. He has been involved in AS/400 and iSeries modernization projects for more than 10 years. He leads the modernization of a COBOL36 and RPG II application named Macro 2000, which he originally co-wrote in the early 1990s. He has a substantial amount of iSeries project experience, working on projects around the world.

James Simons is a Senior Technical Consultant with the Genelco Software Services Division of IBM. He is currently focusing on application modernization. For the past 20 years, he has specialized in developing business and technical solutions for the life insurance industry. He holds several professional insurance industry designations. He has held a variety of technical roles relating to application development including business analyst, technical analyst, developer, project manager, project team leader, director of information services, and head of business operations. He has developed and supported RPG applications for the IBM iSeries platform and all of its predecessors back to the System/34. He has additional development and implementation experience in personal computers, client/server, and Web applications written in Visual Basic®, C++, and Java. He holds a Computer Science degree from Purdue University.

Mark Tregear is a co-founder of Databorough and a lead designer of X-Analysis and its extensions. He has worked on X-Analysis development for the past 15 years and on the AS/400 since its launch. Mark graduated from Cambridge University in Economics. He started work as an RPG programmer on the System 38 in 1981, specializing in financial applications. Currently, he works at the Databorough development center in Weybridge, England.

Thanks to the following people for their contributions to this project:

Mark Rinker
FastLeap, US

Juan Jorge Stromsdorfer B.
I.P.M.-G.S., Columbia

Mike Smith
IBM Systems and Technology Group, Development, Rochester

Jim Diephuis
IBM Systems and Technology Group, On Demand Business, Rochester

Greg Hurlebaus
Cheryl Renner
IBM Systems and Technology Group, Operations eServer Solution Enablement, Rochester

Alison Butterill
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1

Overview: modernization and X-Analysis

This chapter discusses the basic rationale for modernization, introduces X-Analysis, and presents different modernization scenarios. The chapter introduces the Model-View-Controller architecture, one of the end products produced in the modernization scenarios.

This chapter presents the iSeries Developer Roadmap and explains how X-Analysis fits into the roadmap.

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1.1 Why modernize an existing application?

Each company has its own set of reasons for modernizing its applications. Companies do not modernize their applications just to catch the next technology wave. Rather, they are driven by specific business needs, such as:

- Improving application accessibility through open interfaces — The style that companies operate in has changed over the years. Frequently, companies make their core applications accessible to their business partners, customers, and remote workers. Often this access is given via a browser-based interface to the core applications.
- Improving the responsiveness of development — Rapidly changing business needs require development of additional functionality with minimal risk of disrupting applications already in production.
- Improving long-term maintainability — The majority of an application's life is spent in application maintenance. To increase the longevity and decrease maintenance cost, business applications must be refactored to handle change easily.
- Improving portability of applications across platforms — Companies want the flexibility to run their applications on a diverse set of platforms. Applications written in modern programming languages give companies the flexibility to select from a variety of platforms.
- Increasing the ability to attract developers skilled in the new languages — The great majority of newly qualified application developers are skilled in languages other than RPG and COBOL. Requiring new recruits to retrain in the traditional languages is an additional expense and unappealing to the new developers. Finding skilled developers becomes less of a problem when the companies move to the new programming techniques and languages.
- Increasing number of tool options and application packages — The Java and Open Source communities encourage a very competitive software vendor market that supplies tools, techniques, and solutions to companies. Companies can take advantage of these items to improve their application development.

Whatever the business needs driving companies to modernize their applications, they want to ensure that the business logic, a core asset to the company, is preserved. They also want to minimize the pain and effort required to modernize their applications. The following chapters show you how to do just that.

1.1.1 Modern application considerations

Previously, we discussed the main reasons for modernization from a business-need standpoint. Table 1-1 compares traditional applications and modern applications.

Table 1-1 Modern versus traditional applications

Application characteristic	Modern application	Traditional application
Structure	Modular, reusable, component based	Monolithic, intertwined, repetitive code across programs
Componentization	Functionally cohesive	Arbitrary
User Interface	Multiple	5250
Flexibility	Diverse platforms	iSeries and its predecessors

Application structure

RPG and COBOL programs are traditionally implemented in a single-source member. All screen input/output (I/O), file I/O, and business logic are intertwined in a single large module. Enhancing these applications is difficult because the screen I/O, file I/O, and business logic are conjoined. Adding a new user interface such as a browser interface is much more complex in this instance. Contrast this with a program where the business logic has been separated into reusable components that can be used by many programs. This approach allows you to retain the 5250 user interface program that calls the business logic and have a Web-based front end that is using the same business logic.

Modular programs separate the database access from the business logic. For example, instead of directly accessing a payroll file from several programs. Separate procedures provide the database access functions, making it easier to add a field to a table. You make the change in one place instead of modifying every program that accesses that table.

In the past, the business logic was copied into several programs. If the business logic needed to change, each program with the business logic had to be changed. Moving to modern applications where the business logic is isolated into its own separate callable procedure allows any changes to the business logic to be limited to a single module.

Componentization

Monolithic programs are difficult to maintain, becoming brittle over time. For example, a change to the business logic can have unexpected side effects.

Moving from monolithic programs to a component-based architecture requires more than just subdividing the programs. Building an effective component-based architecture requires a design that ensures separation of the application into functionally cohesive modules. The essential feature of these modules must be that the input and output parameters are clearly defined and understood in all possible circumstances. It also requires adherence to good naming conventions for the data files and fields, so that all module interfaces are clearly documented.

User interface

Traditional applications often support only a 5250 user interface.

A modern application needs, at a minimum, to support a browser-based user interface for use both in-house and over the Web. It is also desirable to support other interfaces such as rich client and traditional 5250 data entry screens.

Flexibility

The traditional application is written to run in the same context. It is implemented to support a specific user interface and context and does not easily integrate with other components.

A modern application is made up of components that can be used in different contexts. They can be deployed on different servers, can be used with different user interfaces and can be integrated with other components.

1.2 Architecture a modern application

The key to modernizing an application is to use the right application architecture. The recommended architecture is multi-tiered and based on the Model-View-Controller (MVC) architecture:

- *Model* is the combined business logic and the data.
- *View* is the user interface component.
- *Controller* controls the interactions between the view and the model. It recognizes user interface events.

Figure 1-1 depicts the MVC architecture and its relationship to a three-tier architecture. The three tiers are the presentation layer (representing the view and controller), the (business) logic layer, and the data layer. The Model contains the business logic and the database.

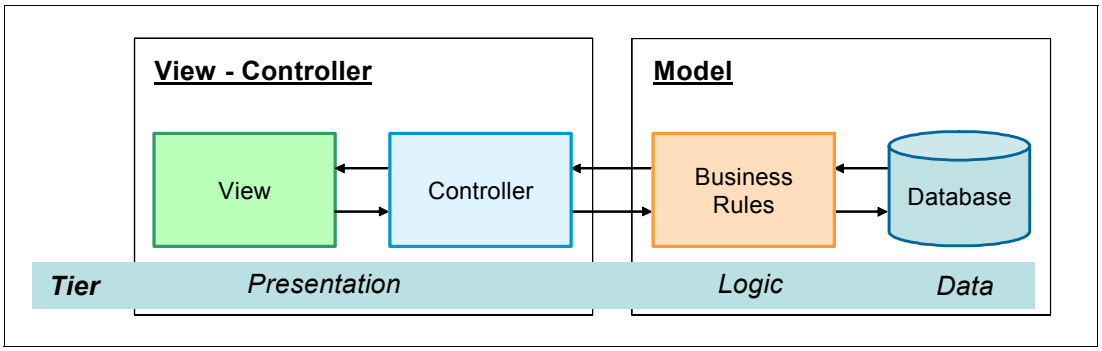

Figure 1-1 MVC and multi-tier architecture

The reason why this architecture is popular is its flexibility. Figure 1-2 on page 5 gives two representations of a multi-tier application. In one scenario (Web Browser User Interface) the view-controller is implemented using a browser and JavaServer Faces (JSF) interacting with an application server. The business logic is in RPG accessing the data layer using Structured Query Language (SQL). The second architecture (Rich Client User Interface) lets you deploy individual components on different systems. The application server could run on one system and invoke the RPG business logic running on another system while the database is located on a third system.

There are two reasons you might want to do this:

- Scalability — At the application server or the business logic tier, enabling you to deploy multiple instances of a component on different systems.
- Security — A firewall can be placed between each component. This ensures that users have controlled access to business logic and the data.

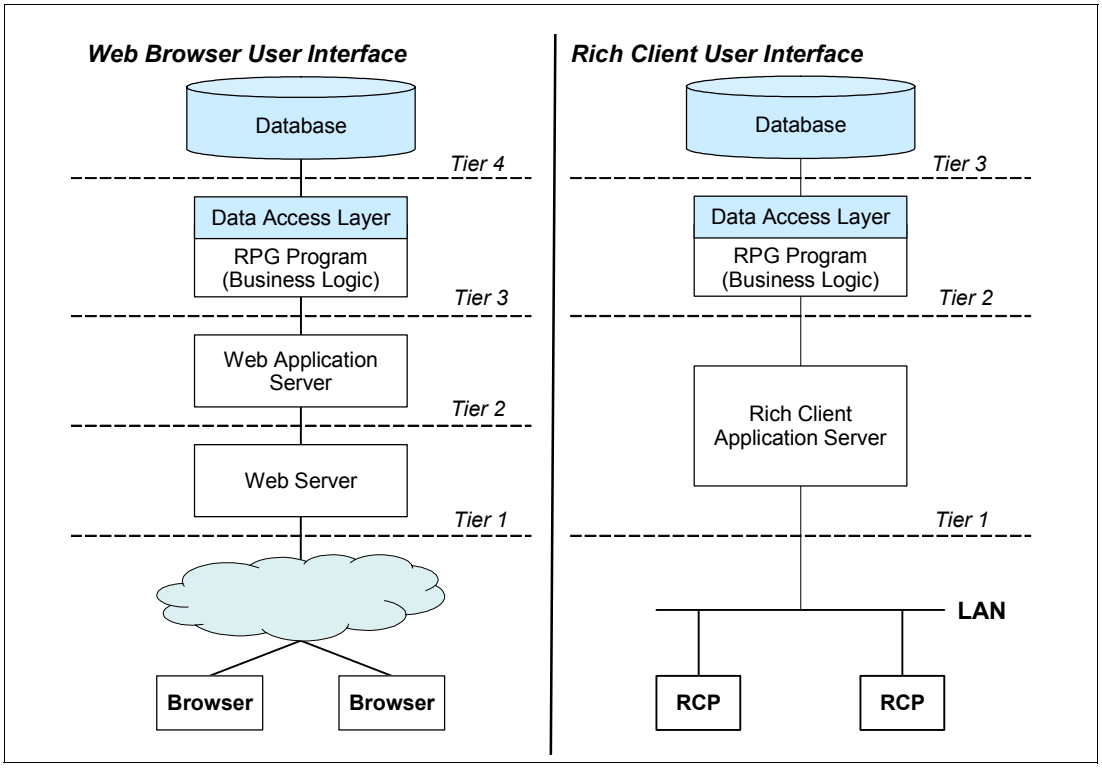

Figure 1-2 Application tiers

1.2.1 Using stateless programs

Traditional 5250 application programs interact directly with the user. The user selects an option from the menu, and a screen is presented. When the user enters data into the screen, the data is stored in a variable. The application holds this data until the program ends. This data is held, even if the user performs additional interactions with the program. This approach works because the program is running in a job associated with a workstation and that job only services requests from that workstation. In this environment, the program state is maintained in variables that are associated with the job.

Contrast this with a browser-based application where each request from the user can be serviced by a different job. In this case the information the user entered cannot be kept in program variables because the next time the user interacts with the application, the application may be running in a different job.

Note: A key point to remember is that a browser-based application may have state information but the state is not kept in the program variables. It may be kept in a cookie and transmitted with each request.

Figure 1-3 on page 6 shows both an existing application and a (modernized) browser-based application. In the traditional application you see each user is tied to a job. This architecture works well with a limited number of users and can scale to support several hundred users by adding memory and processors to a system. However, a Web application must support several thousand users, so it is not practical to have each user connected to a job. Instead, the modern application environment has services that do not rely on state information being stored in program variables. Any required state information is passed through parameters or the context is retrieved based on the values.

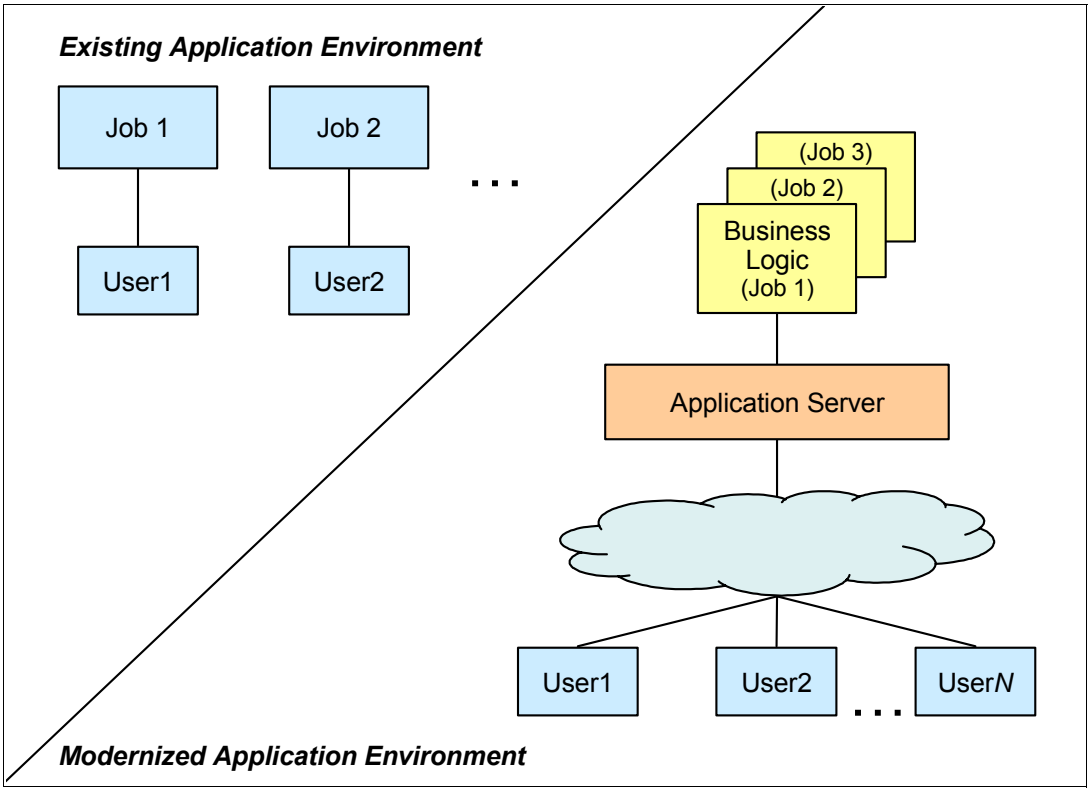

Figure 1-3 Applications environments

1.3 Service-oriented architecture

The long-term goal of modernization is to move to a service-oriented architecture (SOA). SOA is an integration architecture based on the concept of a service. The business and infrastructure functions that are required to build distributed systems are provided as services that individually or collectively deliver application functionality to applications or other services.

Services are the building blocks to SOA, which provide the function for building distributed systems. Services can be invoked independently by either external or internal service consumers. A service can process simple functions or can be chained with other services to form more complex functionality and to quickly devise new functionality.

By adopting an SOA approach and implementing it using supporting technologies, you can build flexible systems that implement changing business processes quickly. This approach enables you to make extensive use of reusable components.

For additional information about SOA refer to *Managing Information Access to an Enterprise Information System Using J2EE and Services Oriented Architecture*, SG24-6371.

1.4 General principles for automated modernization projects

In many cases, implementing and administering any automated application conversion process can be a complex and daunting task. Consider these situations:

- Applications rarely remain static, making it difficult to establish a baseline for implementing and testing the potentially enormous number of application changes.
- Various programming teams within an organization may be working simultaneously on multiple versions of the applications. Each team may have a different task:
  - One team is developing the next release of the application.
  - The test team has another version of the application in quality assurance.
  - The maintenance team is fixing recently reported problems to the production version.
- Frequently, software vendors have different versions of an application to support different customer needs.

Modernization changes should be applied to most or all versions of your applications and products, in all stages of the development life cycle. The effort to apply, test, and promote these modified versions of the applications can be traumatic. Each version of the application generates a new version containing the conversion changes. All development must stop while the converted versions of the applications are tested, refined, and promoted to production. The number of application versions may balloon because of unsuccessful attempts coupled with schedule and budget constraints. This situation creates more maintenance and version control activity, increasing the amount of time and resources required to complete the conversion.

Is it possible to actually get your arms around the effort and carry out the modernization process? Yes, but a sound approach is the key to your success. The following steps outline a recommended and simplified approach that you may want to consider:

1. Clearly delineate the application boundaries to be converted.
2. Copy all delineated objects and source code to a separate library (or set of libraries)
3. Recompile this target conversion library and test the resulting system. This is your control test.
4. Perform a trial conversion process without attempting to freeze the code or administer change management. Significant conversion errors are expected at this stage.
5. The conversion process can be fine-tuned by a mixture of:
   - Improving the quality of the original code
   - Changing conversion parameters
   - Enhancing the conversion software you are using. This may require enhancement to particular software conversion routines.
6. Thoroughly document any manual intervention required in the conversion process, to ensure that the process is repeatable.
7. Iterate through the conversion process enough times to successfully pass all tests to your satisfaction. You are now ready for the live *production* conversion.
8. Freeze development on the delineated application completely for several days (for the duration of the production conversion).
9. Perform the conversion from beginning to end and perform a rapid acceptance test.
10. Use your normal change management procedures to place the converted application into the production source and object libraries.

1.5 Introducing X-Analysis

X-Analysis is an integrated development environment (IDE) used to analyze and enhance existing applications written in RPG, COBOL, Java, and Visual Basic. X-Analysis generates and uses a cross-reference repository, process model, and data model based on the existing application. The repository and the models are the input to X-Analysis's comprehensive cross-referencing, documentation, and re-engineering facilities. The X-Analysis client is used to graphically view, explore, and extract components from these models. A development team can use the X-Analysis client to visually analyze the overall model of an application and to drill down to the precise details of the existing program code.

Figure 1-4 presents the architecture of X-Analysis. The product includes both server-side and client-side components. The cross-reference repository, process model, and data model are built with X-Analysis commands issued on the server. X-Analysis uses all aspects of an application (source codes, display files, and database file) to generate the repository and models. After the repository and models are built, the developer can graphically view and access them using the X-Analysis client.

The X-Analysis client can be used to re-engineer an existing RPG application to an MVC architecture. The X-Analysis client generates JavaServer Faces for the existing user interface, JavaBeans for the user interface handling, and stored procedures to interact with the database. X-Analysis can produce standard functions representing idealized logical screens for searching and updating the application. X-Analysis includes abstract Java classes to support this component-based architecture.

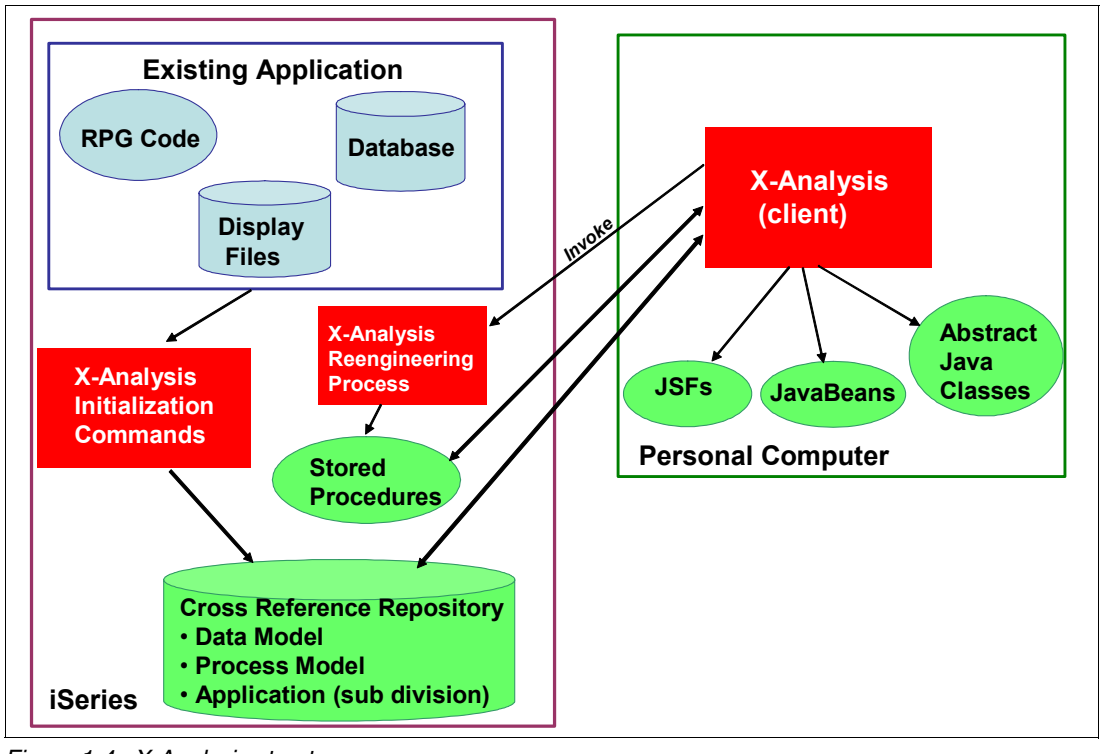

Figure 1-4 X-Analysis structure

X-Analysis can also be used to generate a partial model of the application (known as an *application area*). Generating a partial model is performed using X-Analysis to subdivide the application into areas based on an interrelated set of files, programs, or both. Typically an application area is used when the goal is to modernize a subset of the existing application.

X-Analysis benefits companies with large existing applications with any of the following characteristics:

- Lack understanding of the application requiring enhancements.
- Must quantify and plan the impact of proposed design modifications.
- Must improve their data integrity.
- Must improve the testing process for existing or modernized applications.
- Need to recover the implicit data model and extracted business rules.
- Require a new user interface to interact with existing business rule logic without rewriting the existing application.

1.5.1 X-Analysis components

X-Analysis consists of a foundation product and various extensions that can be installed as needed by the customer. Figure 1-5 shows the X-Analysis product with various extensions and how they fit together.

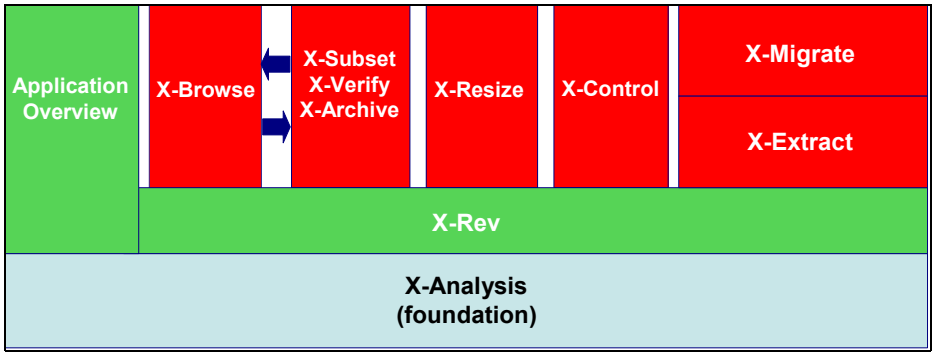

Figure 1-5 X-Analysis components

Note: X-Browse interacts with X-Subset, X-Verify, and X-Archive, and they are often purchased together.

Each of the modules provide important capabilities to the development team. X-Analysis is described as follows:

- *X-Analysis* (foundation) provides the core cross-referencing capabilities:
- Performs application and data model generation.
- Provides cross-referencing with drilldown to specific details (variables, fields, or lines of code).
- Enables interactive viewing of source code, application structure diagrams, and data flow diagrams.
- Gives a graphical view of all aspects of the existing application and the object where used.
- *X-Rev* reverse engineers higher-level modeling information not directly contained in the existing code:
  - Extracts the data model implicit in the existing application.
  - Generates a data encyclopedia or data dictionary.
  - Aids data field analysis.
  - Documents data entity relationships.

- *Application Overview* (usually accompanies X-Rev) provides comprehensive documentation and application subdivision capabilities:
  - Subdivides the application as needed based on the models.
  - Presents RPG code as pseudo code.
  - Documents business rule logic.
  - Provides Microsoft® Word and Visio® documentation wizards.
  - Enables viewing model subsets.
  - Provides export and source configuration management software tools.
- *X-Browse* enables you to view and navigate your database using the extracted data model:
  - Provides instant query and report applications (without programming).
  - Creates joins for related data files.
  - Provides drilldown links to all dependant data files.
  - Optimizes application performance using existing logical views.
  - Identifies available access paths and views.
  - Provides a completely formatted display of OS/400® journals for application data.
- *X-Subset, X-Verify and X-Archive* aid in application testing and data archiving:
  - X-Subset builds a referentially consistent test data set for application testing.
  - X-Verify enables the testing of the referential integrity of production data based on the data model.
  - X-Archive handles selected or complete data archiving with selection criteria and audit trails. It also ensures that referential integrity is maintained in the remaining data (in other words no records are orphaned).
- *X-Resize* provides automated data file and field re-engineering:
  - Provides impact analysis for all data instances (such as fields, variables, programs, files).
  - Provides exception reporting for special conditions and overlapping.
  - Includes automated:
    - Source conversion for all objects and source types
    - Bulk recompile
    - Data conversions
- *X-Control* provides automated and integrated change management services:
  - Offers a single command request for programmer changes.
  - Provides parallel machine support.
  - Includes various controls and audits:
    - Control of modules returned to systems (by identification)
    - Audit history
    - Archiving of source and object code
  - Interfaces to documentation in Microsoft Office or text files.
- *X-Extract* identifies and expresses business rule logic from individual programs or parts of the system:
  - Extracts a comprehensive database of business rules implicit in the existing code.

  - Provides narrative documentation of each extracted business rule, enabling them to be viewed either stand alone or in the context of the programs from which they have been extracted.
  - Generates a complete Data Definition Language from the data model.
  - Generates XML Metadata Interchange (XMI) format from the model.
- *X-Migrate* deconstructs the existing application into new components, which can then be deployed in modern environments (such as a Web server environment)
  - Generates data access objects for use with modern user interfaces.
  - Generates a generic controller following Model-View-Controller architecture.
  - Generates stateless business rule components from the RPG applications.

1.6 X-Analysis and the iSeries Developer Roadmap

As new technology comes along, existing programming languages and related programming models change to incorporate and take advantage of these advancements. The iSeries Developer Roadmap, created by IBM, shows how companies with traditional 5250 applications can evolve those applications to incorporate the new programming languages and methodologies. The roadmap as shown in Figure 1-6 consists of six pillars. Each pillar identifies a modernization goal and the programming languages and technology associated with that pillar. The six pillars are:

- Traditional

  Existing RPG or COBOL applications with a 5250 user interface. The applications frequently rely on a programming model where all aspects of the application are included in a single module, making the application hard to maintain and change.

- Improve your productivity

  The use of technology and tools to maintain existing applications without unnecessary change.

- Enhance the end user experience

  Restructuring the presentation layer of the application, making it suitable for use with graphical and browser interfaces.

- Create a modular architecture

  An application is redesigned to take advantage of new programming models, such as the Model-View-Controller architecture. An objective of this phase is to separate the various aspects of the application into reusable components.

- Integrate applications

  As business needs change, companies create or purchase new applications. These applications are frequently written in new programming languages. It is important that the existing applications and new applications can share data.

- Integrate business processes

  Businesses must react quickly to change. Business processes can be affected by these changes. As business processes change, the applications that support them must change as well. The goal of this pillar is to incorporate technology that enables all aspects of the business to react quickly to change.

Aligning your business applications with any of the pillars can cause improvements to your business and development environment. It is important to evaluate your business needs to understand the form of modernization that is right for your company.

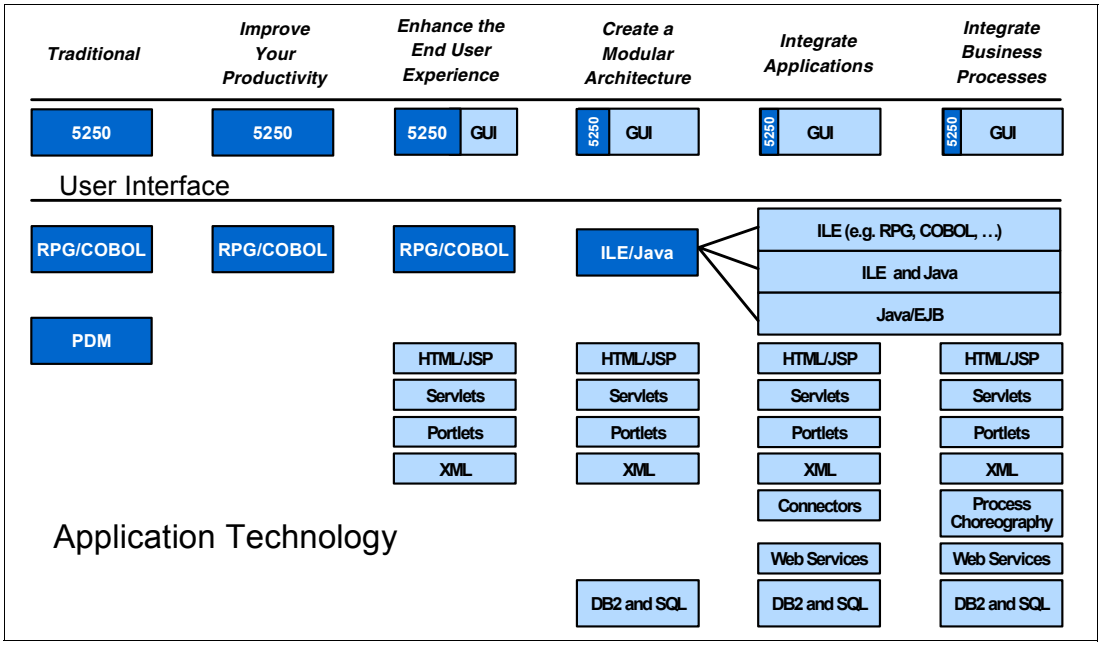

Figure 1-6 iSeries Developer Roadmap (technology view)

1.6.1 Future tools view of the iSeries Developer Roadmap

In order to realize the benefits of the iSeries Developer Roadmap, IBM through its IBM eServer iSeries Initiative for Innovation program has developed a corresponding future tools view of the roadmap (Figure 1-7 on page 13). This view identifies tools and technology that enhance your application modernization effort. Both IBM and Business Partner tools and technology are included in this roadmap.

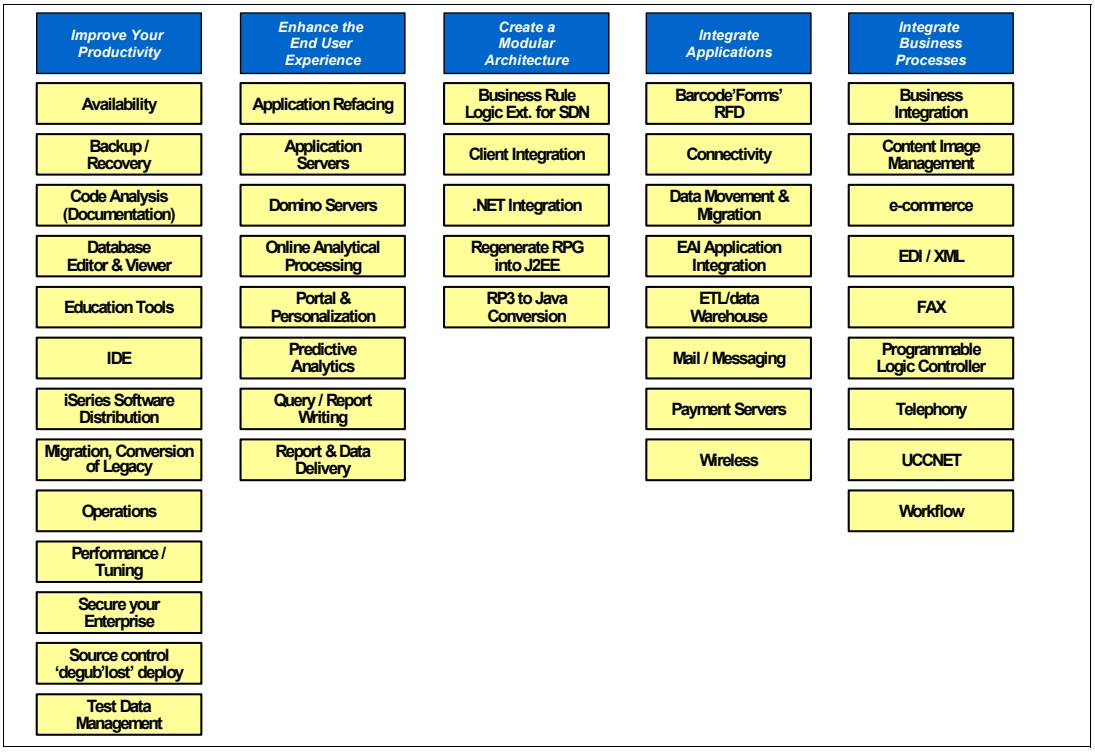

Figure 1-7 iSeries Developer Roadmap - Future Tools View

1.6.2 X-Analysis and the roadmap

X-Analysis provides capabilities that fit within the first three pillars shown in Figure 1-7. The pillars are mapped to X-Analysis as follows:

- Improve your productivity: X-Analysis's primary function is to improve the productivity of the application development team. It accomplishes this through a rich set of documentation and navigation capabilities. X-Analysis allows developers quick access to cross-referencing functions, graphical structure displays, and process flow information. The existing applications' implicit data model and business rules can be extracted. Development teams can use X-Analysis to understand and maintain their current RPG and COBOL applications.
- Enhance the end user experience: X-Analysis provides the capabilities that enable a business to improve the application user interface and increase the flexibility of applications. X-Analysis extensions provide the means to generate JavaServer Faces (JSF) and JavaBeans, which provide a new user interface for the existing application.
- Create a modular architecture - X-Analysis assists in recovering design information necessary to re-engineer selected application areas and to prepare the move to a component-based architecture such as MVC architecture. In order to accomplish this transformation, application programmers and analysts need a deep understanding of their business logic and data model. X-Analysis dynamically extracts the data model and process model specific to each application area. The developers can then drill down into the detail of the business rule logic involved. Developers find the cross-referencing and documentation functions extremely helpful when creating a new component-based architecture.

1.7 X-Analysis modernization scenarios

As stated previously, X-Analysis plays an important role in application modernization. This section identifies three business scenarios and suggests the paths available to modernization.

1.7.1 Business scenario 1

The first scenario introduces a software vendor with many years of RPG programming experience and some Java and Web development skills. They have a large application with too many programs to consider converting them by hand. The team does not know how much effort would be required to modernize the application. Most of the applications are written in Original Program Model (OPM) RPG and a few are written in Integrated Language Environment (ILE) RPG. The company faces competitive pressure to provide browser-based interfaces and rich client support.

Therefore this company has decided to totally transform the presentation and control layers of their application to the MVC architecture.

1.7.2 Business scenario 2

The company in this scenario develops most of its applications in-house, using both OPM and ILE RPG. Their biggest concern is the amount of time at it takes to respond to new requests for added functionality. Often instead of trying to reuse existing programs, they create a new version of an existing program, compounding their maintenance problems. For example, in a recent project requiring the expansion of the customer number field from five digits to seven digits, they spent much more time than was budgeted. They know they must deal with these maintenance issues and find a new approach to handling enhancements. However, re-architecting the applications and using Java are not an option, at least not any time soon.

For this scenario, the customer needs clear documentation and an approach that will improve maintenance productivity without making any radical change to their applications. The company wants to take a conservative approach with minimal change and disruption while achieving improved maintenance productivity and the ability to add new function.

1.7.3 Business scenario 3

This company has highly skilled RPG and Java developers on staff, doing sophisticated iSeries and Web development. The application suite of RPG programs has grown over the years in an ad hoc manner. The RPG applications were developed quickly to respond to business opportunities with little thought of how they would be maintained or enhanced as business conditions changed. The company now has a large number of complex applications that are difficult to enhance, which prevents them from responding to business opportunities quickly. The IT executive and staff decided that future projects will be developed using modern methodologies when possible. They will write Java components when appropriate, rework the RPG code to components as necessary, or port the RPG code to Java when the effort to rework the RPG code is too expensive.

The executive wants to modernize the applications incrementally. He knows that converting all of the applications at one time would be a disaster. The company is looking for a method to help the staff isolate application areas, recover the business logic and the data model from the existing application, and re-engineer the application where possible.

This company is typical of situations where modernization occurs on an application section by section basis. One section of the application is rebuilt at a time, but when each section is rebuilt, a thorough modernization is required.

2

Introducing the sample application

This chapter discusses the sample application used in this paper. The sample application represents a typical existing RPG application targeted for modernization. A typical application resides in a library containing both the production application modules and extraneous source code, objects and data files that are no longer used. The extra items are not part of the production application but are still in the library for a variety of reasons.

The chapter first explains the Customer Management System and lists the additional files and programs in the application library.

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2.1 About the sample application

In order to show the capabilities of X-Analysis, we are using the sample application library (XRAPPS), which contains the Customer Management System (CMS) application and related data files, along with additional RPG programs, display files, and data files. These additional files are included to demonstrate the ability of X-Analysis to delimit application areas that are targeted for application modernization. In the subsequent chapters, you see how X-Analysis can make sense of a typical application library and how to recover a particular subset of a larger application.

It is a common situation for existing application libraries to contain extraneous content such as program copies, obsolete programs, test programs, versions of programs, and unused data files. This situation often occurs as business applications evolve and are enhanced over a number of years. By adding extra programs and data files to the CMS library (XRAPPS), we simulate this condition.

The contents of the XRAPPS library are presented in two steps:

1. The CMS application is discussed.
2. The additional data files and programs in the XRAPPS library are listed.

2.2 Overview of the Customer Management System

The Customer Management System (CMS) (in this paper) is a version of the RPG application used by Databorough to manage their customer and contact information and related details. This application was developed by Databorough for their own use. They have been using the application for a number of years and over time it has been enhanced and extended to meet changing business needs.

Databorough has distributors that support specific territories around the world. Each distributor has salespersons who promote the product through contacts at prospective customer sites. The customers who purchase the product sign maintenance contracts at which time the customer is given a unique security code. The CMS application is used by the sales organization and distributors to maintain customer relationship information such as customer, contact, and contract information.

2.2.1 Customers Main Menu

CMS is started using these steps:

1. Add the application library to the iSeries library list. Enter:

```
addlible XRAPPS
```

2. To start the application on the iSeries, enter:

```
go XCMMENU
```

When the application is invoked, the Customers Main Menu (Figure 2-1 on page 17) enables the distributors and sales people to access and maintain the customer-related information.

```
Customers                    M A I N   M E N U              Databorough Ltd.
XCMMENU                                                            15:37:22
                                                                    9/16/05

Select one of the following:

     1.  Customer Site Maintenance
     2.  Organisation Maintenance
     3.  Account Maintenance
     4.  Work with Customer Contacts
     5.  Work with Customer Sites
     6.  Work with Rep. Delivery Areas


Selection or command
===>

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
F13=Information Assistant  F16=AS/400 main menu
```

Figure 2-1 Customers Main Menu

The programs associated with the main menu are:

- Customers Main Menu (XCMMENU)
- Customer Site Maintenance (CUSFMAINTC)
- Organization Maintenance (ORGMNT)
- Account Update (CUS002)
- Work with Customer Contacts (WWCCONSC)
- Work with Customer Sites (WWCUSF)
- Work with Rep. Delivery Areas (WWRAREASC)

Option 1: Customer Site Maintenance

Figure 2-2 shows the Customer Site Maintenance screen flow and lists the screens associated with this option.

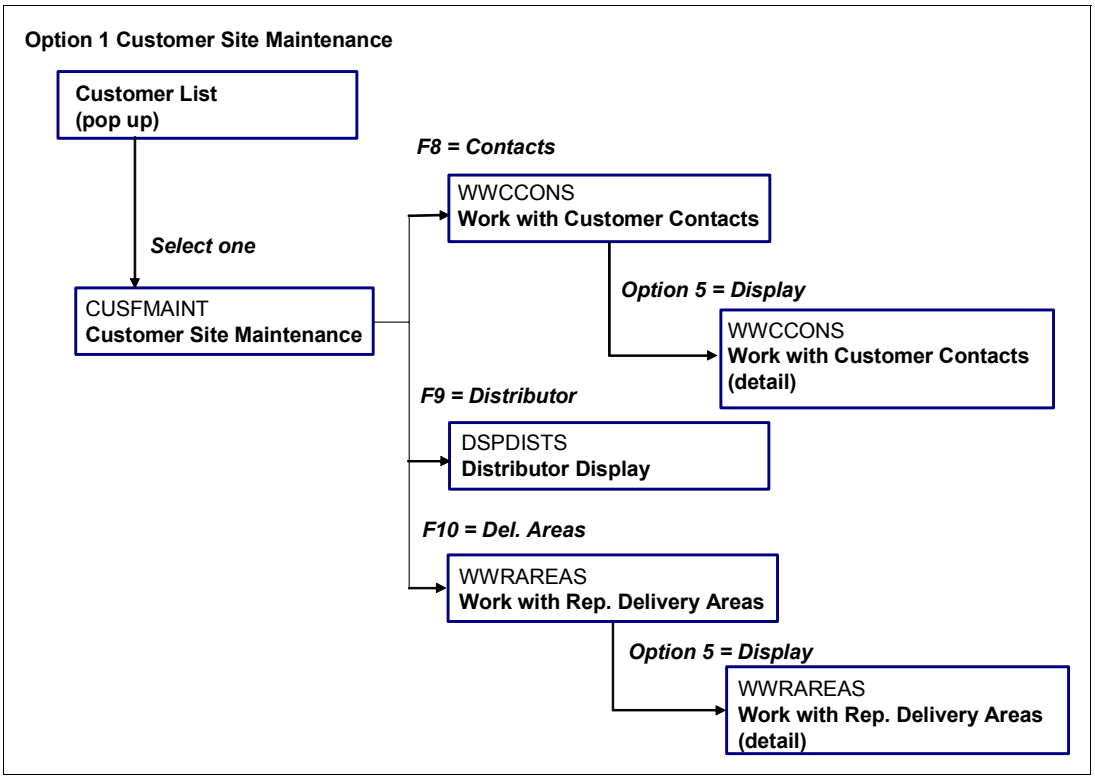

Figure 2-2 Customer site maintenance flow

When option 1 is selected from the Customers Main Menu, the customer list (Figure 2-3) is displayed. To work with a particular customer, select that customer from the list.

```
Customers                   M A I N   M E N U              Databorough Ltd.
XCMMENU                                                           15:46:00
                                                                   9/16/05

Select one of the following:

         Please select:
           00001 Bertwhistle & Compan
           00002 Turpin Computers
           00004 Teflon Company of G.
           00005 Turbine Components L
           00006 Gough Research plc
           00009 Newt Foods UK Ltd.
           00014 Bock & Co. Ltd
           00015 Besson Bros.
           00017 Media Enterprises Lt
           00018 Bays Engineering Lt +

Selec
===> 1

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
F13=Information Assistant  F16=AS/400 main menu
```

Figure 2-3 Customer list

When a customer is selected, in this case Bertwhistle & Company Ltd., the Customer Site Maintenance screen appears (Figure 2-4).

```
Customers          Customer Site Maintenance               Databorough Ltd.
CUSFMAINT                                                         15:48:42
                                                               16 Sep 2005
Customer No . . . . . . . 00001
Customer Name . . . . . . Bertwhistle & Company Ltd
Address . . . . . . . . . Harmon ross
                          Halesowen Road
                          Cradley Heath
                          Warley   West Midlands
Country . . . . . . . . .
Postcode  . . . . . . . . B64 7JB
Telephone No  . . . . . . 0121 550 1841
Fax. No . . . . . . . . . 0121 550 753
Email Address . . . . . . jdawson@bertco.com
Website . . . . . . . . . www.bertco.com
Distributor, Salesperson  DT  STU
Status  . . . . . . . . . 5
Contact . . . . . . . . . Janet Dawson
Title . . . . . . . . . . Mrs
Job Title . . . . . . . . Financial Director
Last Contact Date . . . . 2003-05-14
Next Contact Date . . . . 2003-10-25
Please make required changes. (F8=Contacts,F9=Distributor,F10=Del.Areas)
```

Figure 2-4 Customer Detail (select one)

The Work with Customer Contacts screen (Figure 2-5) appears when F8 is selected from the Customer Site Maintenance screen.

```
Customers            Work with Customer Contacts             Databorough Ltd.
WWCCONS                                                              15:50:20
                                                                   2005-09-16
Customer No: 00001
Enter options, press Enter.
5=Display

     Prod. Name                                Tel. No.

     XC


F1=Help  F3=Exit  F12=Cancel
```

Figure 2-5 Work with Customer Contacts (F8)

The Work with Customer Contacts detail screen (Figure 2-6) shows the detail of the Product selected (option 5).

```
Customers            Work with Customer Contacts             Databorough Ltd.
WWCCONS                                                              15:50:20
                                                                   2005-09-16
 Customer No  . . . . .    00001
 Product Code . . . . .    XC
 Contact  . . . . . .
 Telephone No . . . . . .
 Fax No . . . . . .

 Last Contact Date  . . .  2003-05-01
 Next Contact Date  . . .  2003-10-25
 Salesperson  . . . . . .
 Status . . . . . .  S


F1=Help  F3=Exit  F12=Cancel
```

Figure 2-6 Work with Customer Contacts (details)

If you had selected F9 from the Customer Site Maintenance screen, the Distributor Display for that customer would appear (Figure 2-7).

```
Customers             Distributor Display                    Databorough Ltd.
DSPDISTS                                                             16:04:27
                                                                   2005-09-16


Distributor Code  . . . . DT

Distributor Name  . . . . Databorough Tech


F3=Exit  F12=Cancel
```

Figure 2-7 Distributor Display (F9)

If you had selected F10 from the Customer Site Maintenance screen, the Work with Rep. Delivery Area for that customer would display (Figure 2-8).

```
Customers           Work with Rep. Delivery Areas            Databorough Ltd.
WWRAREAS                                                            16:15:03
                                                                  2005-09-16
Rep: STU
Enter options, press Enter.
5=Display

     Code  Description

     RSA   Republic of South Africa
     UKS   United Kingdom South


F1=Help  F3=Exit  F12=Cancel
```

Figure 2-8 Work with Rep. Delivery Areas (F10)

You can select option 5 (display) on the Work with Rep. Delivery Areas to display more detail (Figure 2-9).

```
Customers           Work with Rep. Delivery Areas            Databorough Ltd.
WWRAREAS                                                            16:15:03
                                                                  2005-09-16
 Rep. Code  . . . . . .    STU
 Area Code  . . . . . .    RSA
 Area Description . . . .  Republic of South Africa


F1=Help  F3=Exit  F12=Cancel
```

Figure 2-9 Work with Rep. Delivery Areas (detail)

Option 2: Maintain Organizations

Figure 2-10 depicts the Maintain Organizations screen flow.

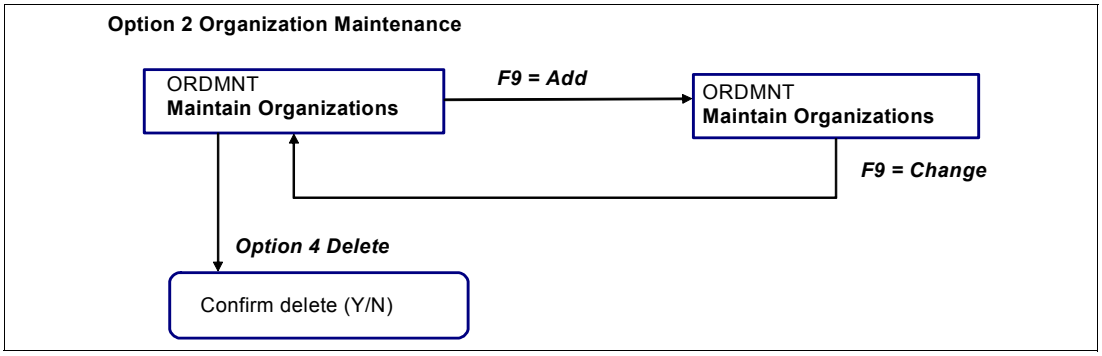

Figure 2-10 Organization Maintenance flow

When option 2 is selected from the Customers Main Menu, Maintain Organizations (Figure 2-11) displays the organizations.

```
QPADEV0006 ORGMNT              Databorough Ltd.                      9/16/05
CHANGE     LINDAMAY        Maintain Organisations                   16:19:00


  Org.

Type options, press Enter.
4=Delete

X Org.  Name                           Created    Create   Updated    Update
                                       by         Date     by         Date
      1 Acoustical Turbines Ltd        STU         1/02/13 STU         1/02/13
      2 Acorn Harvesters plc           STU         1/02/13 STU         1/02/13
      3 Zenith Sound Systems           STU         2/08/12 STU         2/08/12
      4 Databorough Ltd                AMIT        5/09/15 AMIT        5/09/15


                                                                        Bottom
F1=Exit   F9=Add
```

Figure 2-11 Maintain Organization Information

If you press F9 (add), you can add organizations (Figure 2-12).

```
QPADEV0006 ORGMNT              Databorough Ltd.                      9/16/05
ADD        LINDAMAY        Maintain Organisations                   16:22:29



  Org.  Name                           Created    Create   Updated    Update
                                       by         Date     by         Date
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
      0                                           0/00/00             0/00/00
                                                                      More...
F1=Exit   F9=Change
```

Figure 2-12 Add organization information

Option 3: Account Maintenance

Figure 2-13 depicts the Account Maintenance screen flow.

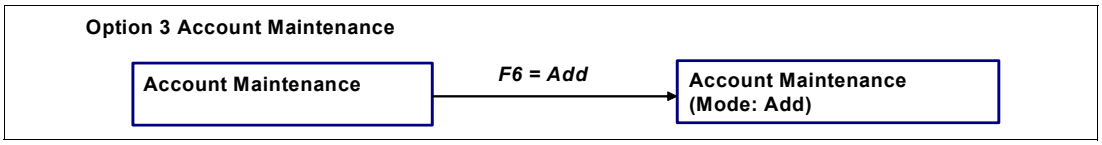

Figure 2-13 Account Maintenance flow

When option 3 is selected from the Customers Main Menu, the Account Maintenance screen (Figure 2-14) displays.

```
DATE  9/16/05   CUSO02     ACCOUNT MAINTENANCE                    TIME 16:27


COM  DIV  CUST    PLACE
 OO  OOO
                 FOR MASTER



F3=Exit  F4=PROMPT  F6=ADD
```

Figure 2-14 Account Maintenance

Press F6 (add) to reach the Account Maintenance screen in add mode (Figure 2-15).

```
OO OOO
DATE  9/16/05   CUSO02     ACCOUNT MAINTENANCE                    TIME 16:27
                              MODE:   ADD
NAME                                        NUMBER          1
ADD. 1                                      ABBR.
ADD. 2                                      TEL NO.     OOO OOOOOOO
CITY                              ST        FAX :       OOO OOOOOOO
ZIP CODE
                                            T.NUMBER
URL

T.CODE      O          TERM CODE          START DATE
STMT        Y          CNT.CLASS          CR. HOLDER     N           30
A/C TYPE               FORMAT       OO    REVIEW DATE
REP                    STMT NOTE    N     TAX PCT.
DLRY ZONE                     DAYS        EXCHANGE RATE
INVOICE     N          I/C          N     ADD(REMIT)
FIN         N          P/P Tck      N     REF.
CBD         N          CASH         N     G/L NUMBER
COD         N          PLACE
FRT CHG     N          DISC.1%


F3=EXIT  F4=PROMPT  F12=PREVIOUS  F14=W/O INQUIRY F23=DELETE
```

Figure 2-15 Account Maintenance (add mode)

Option 4: Work with Customer Contacts

Figure 2-16 depicts the Work with Customer Contacts screen flow.

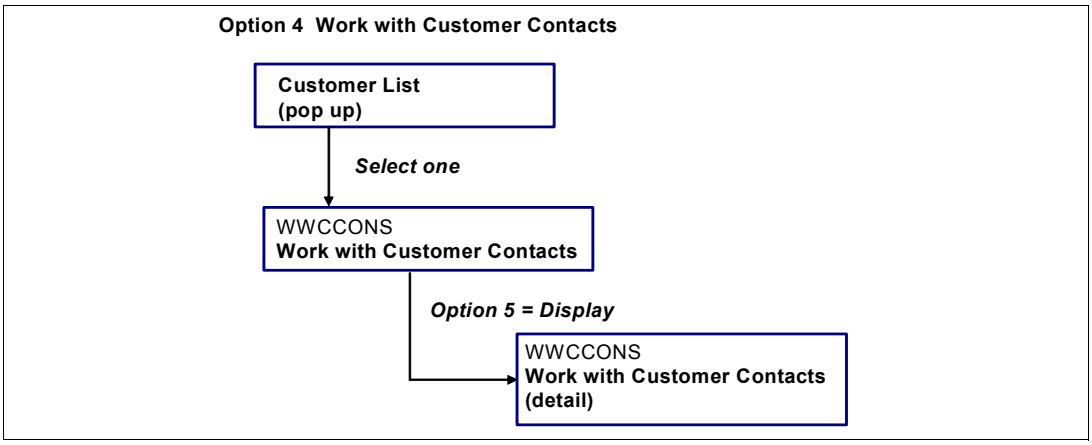

Figure 2-16 Work with Customer Contacts flow

When option 4 is selected from the Customers Main Menu, the customer list (Figure 2-17) is displayed.

```
Customers                    M A I N   M E N U              Databorough Ltd.
XCMMENU                                                            16:31:57
                                                                    9/16/05

Select one of the following:

          Please select:
            00001 Bertwhistle & Compan
            00002 Turpin Computers
            00004 Teflon Company of G.
            00005 Turbine Components L
            00006 Gough Research plc
            00009 Newt Foods UK Ltd.
            00014 Bock & Co. Ltd
            00015 Besson Bros.
            00017 Media Enterprises Lt
            00018 Bays Engineering Lt +

Selec
===> 4

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
F13=Information Assistant  F16=AS/400 main menu
```

Figure 2-17 Work with Customer Contacts (customer list)

The Work with Customer Contacts (Figure 2-18 on page 25) is displayed by selecting a customer.

```
Customers            Work with Customer Contacts             Databorough Ltd.
WWCCONS                                                              16:33:39
                                                                   2005-09-16
Customer No: 00001
Enter options, press Enter.
5=Display

     Prod. Name                                Tel. No.

     XC



F1=Help  F3=Exit  F12=Cancel
```

Figure 2-18 Work with Customer Contacts (select one)

To see the Work with Customer Contacts detail (Figure 2-19) select option 5 (beside a product name).

```
Customers            Work with Customer Contacts             Databorough Ltd.
WWCCONS                                                              16:33:39
                                                                   2005-09-16
 Customer No  . . . . .    00001
 Product Code . . . . .    XC
 Contact  . . . . . . . .
 Telephone No . . . . . .
 Fax No . . . . . . . . .

 Last Contact Date  . . .  2003-05-01
 Next Contact Date  . . .  2003-10-25
 Salesperson  . . . . . .
 Status . . . . . . . . .  S


F1=Help  F3=Exit  F12=Cancel
```

Figure 2-19 Work with Customer Contacts detail (Option 5)

Option 5: Work with Customer Sites

Figure 2-20 on page 26 depicts the Work with Customer Sites screen flow. The Customer Site Maintenance screen options (with the blue background) are not replicated in this section because they were shown previously. The screens not repeated are:

- Work with Customer Contacts screen (F8 from the Work with Customer Sites screen) is shown in Figure 2-5 on page 20. The associated Work with Customer Contacts detail screen shown in Figure 2-6 on page 20.
- Distributors Display (F9 from the Work with Customer Sites screen) is shown in Figure 2-7 on page 20.
- Work with Rep. Delivery Areas (F10 from the Work with Customer Sites screen) is shown in Figure 2-8 on page 21. The associated Work with Rep. Delivery Areas detail screen is shown in Figure 2-9 on page 21.

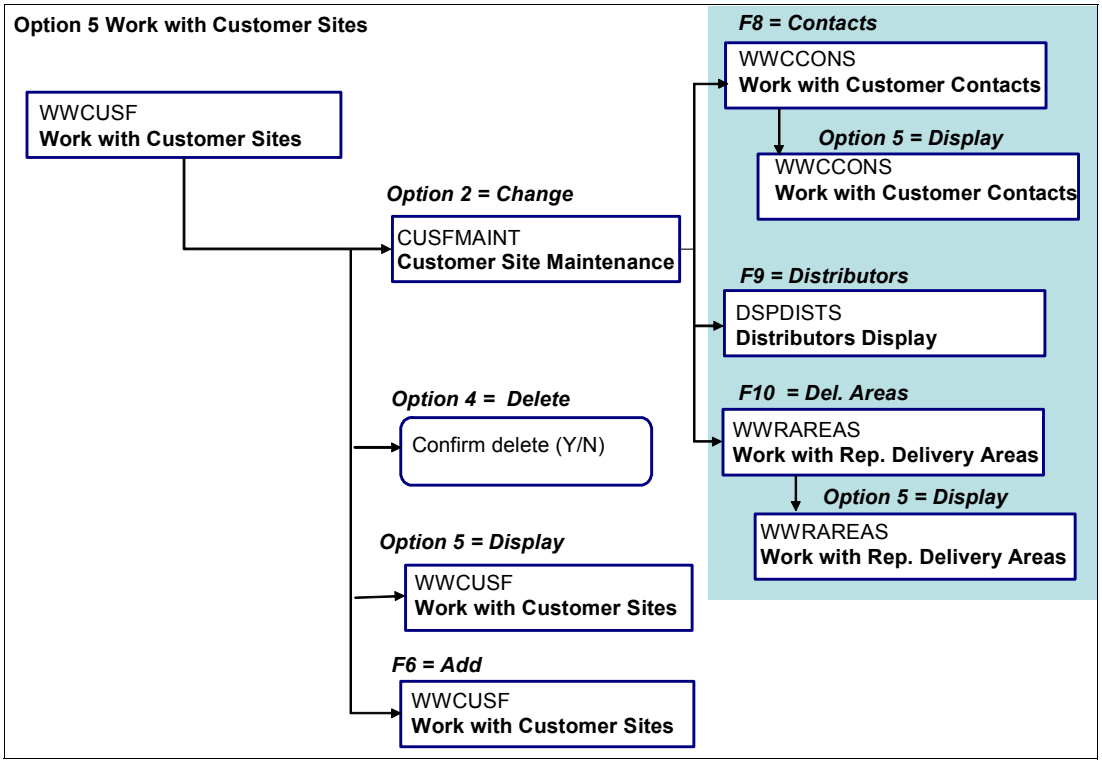

Figure 2-20 Work with Customer Sites flow

When option 5 is selected from the Customers Main Menu, the Work with Customer Sites (Figure 2-21) is displayed.

```
Customers             Work with Customer Sites              Databorough Ltd.
WWCUSF                                                             16:35:53
                                                                2005-09-16

Enter options, press Enter.
2=Change    4=Delete    5=Display

     No.   Name                              Tel. No.

     00001 Bertwhistle & Company Ltd         0121 550 1841
     00002 Turpin Computers                  0170 152 4878
     00004 Teflon Company of G.B. Ltd.       0191 568 8899
     00005 Turbine Components Ltd            0443 250 5151
     00006 Gough Research plc                0191 967 0007
     00009 Newt Foods UK Ltd.                0191 272 8930
     00014 Bock & Co. Ltd                    0561 624 0333
     00015 Besson Bros.                      05673 722651
     00017 Media Enterprises Ltd             0181 223 2552
     00018 Bays Engineering Ltd              06794 462199
     00021 Goldfish & Sons Ltd.              0561 552 4959
     00026 Linhouse Limited                  03498 336501                +

F1=Help  F3=Exit  F6=Add  F12=Cancel
```

Figure 2-21 Work with Customer Sites

By selecting option 2 (change) the Customer Site Maintenance screen (Figure 2-22) is displayed.

```
Customers          Customer Site Maintenance                Databorough Ltd.
CUSFMAINT                                                          16:38:13
                                                                16 Sep 2005
Customer No . . . . . . . 00001
Customer Name . . . . . . Bertwhistle & Company Ltd
Address . . . . . . . . . Harmon ross
                          Halesowen Road
                          Cradley Heath
                          Warley   West Midlands
Country . . . . . . . . .
Postcode  . . . . . . . . B64 7JB
Telephone No  . . . . . . 0121 550 1841
Fax. No . . . . . . . . . 0121 550 753
Email Address . . . . . . jdawson@bertco.com
Website . . . . . . . . . www.bertco.com
Distributor, Salesperson  DT  STU
Status  . . . . . . . . . 5
Contact . . . . . . . . . Janet Dawson
Title . . . . . . . . . . Mrs
Job Title . . . . . . . . Financial Director
Last Contact Date . . . . 2003-05-14
Next Contact Date . . . . 2003-10-25
Please make required changes. (F8=Contacts,F9=Distributor,F10=Del.Areas)
```

Figure 2-22 Customer Site Maintenance

Selecting a particular customer (option 5 from the Work with Customer Sites screen) causes the Work with Customer Sites detail screen (Figure 2-23) to display.

```
Customers            Work with Customer Sites               Databorough Ltd.
WWCUSF                                                             16:35:53
                                                                2005-09-16
 Customer No  . . . . .    00001
 Customer Name  . . . .    Bertwhistle & Company Ltd
 Address  . . . . . . . .  Harmon ross
                           Halesowen Road
                           Cradley Heath
                           Warley   West Midlands
 Country  . . . . . . . .
 Postcode . . . . . . . .  B64 7JB
 Telephone No . . . . . .  0121 550 1841
 Fax. No  . . . . . . . .  0121 550 753
 Email Address  . . . . .  jdawson@bertco.com
 Website  . . . . . . . .  www.bertco.com
 Distributor. . . . . . .  DT
 Status . . . . . . . . .  5
 Contact  . . . . . . . .  Janet Dawson


F1=Help  F3=Exit  F12=Cancel
```

Figure 2-23 Work with Customer Sites (display)

To add a new customer, select F6 from the Work with Customer Sites screen. The Work with Customer Sites (in add mode) is displayed (Figure 2-24).

```
Customers             Work with Customer Sites              Databorough Ltd.
WWCUSF                                                             09:52:15
                                                                2005-09-19

 Customer No  . . . . .    00000
 Customer Name  . . . .
 Address  . . . . . . . .

 Country  . . . . . . . .
 Postcode . . . . . . . .
 Telephone No . . . . . .
 Fax. No  . . . . . . . .
 Email Address  . . . . .
 Website  . . . . . . . .
 Distributor. . . . . . .
 Status . . . . . . . . .
 Contact  . . . . . . . .


 F1=Help  F3=Exit  F12=Cancel
```

Figure 2-24 Work with Customer Sites (add)

Option 6: Work with Rep. Delivery Area

Figure 2-25 depicts the Work with Rep. Delivery Areas screen flow.

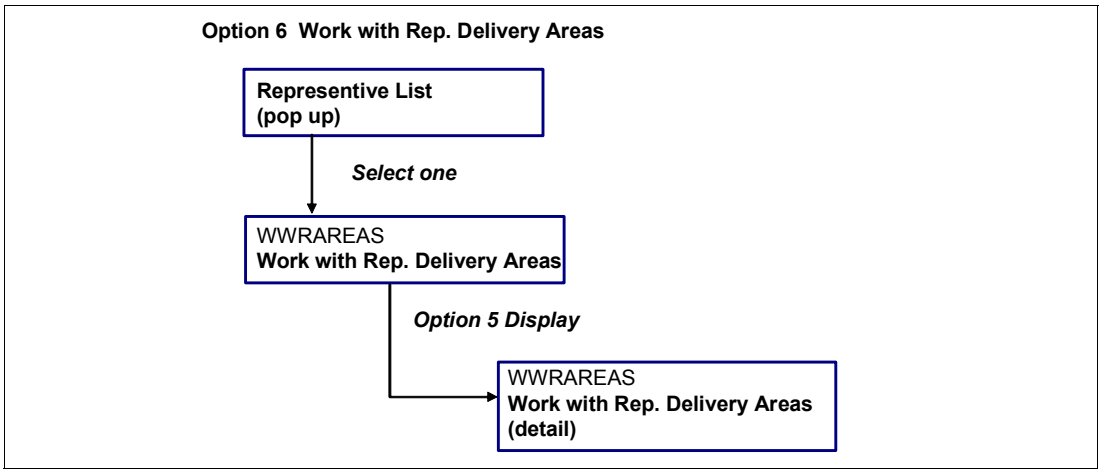

Figure 2-25 Work with Rep. Delivery Areas flow

When option 6 is selected from the Customers Main Menu, the representatives list (Figure 2-26 on page 29) is displayed.

```
Customers                   M A I N   M E N U               Databorough Ltd.
XCMMENU                                                            16:48:00
                                                                    9/16/05

Select one of the following:

         Please select:
           JKL Johan Klaassen
           MTT Mark Tregear
           NWD Neil Woodhams
           STU Stuart Milligan


Selec
===> 6

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
F13=Information Assistant  F16=AS/400 main menu
```

Figure 2-26 Delivery area list

After a particular representative is selected, the Work with Rep. Delivery Area (Figure 2-27) is displayed.

```
Customers           Work with Rep. Delivery Areas            Databorough Ltd.
WWRAREAS                                                           16:49:44
                                                                 2005-09-16
Rep: JKL
Enter options, press Enter.
5=Display

     Code  Description

     NDL   Netherlands
     UKW   United Kingdom WEST


F1=Help  F3=Exit  F12=Cancel
```

Figure 2-27 Work with Rep. Delivery Areas (select one)

When a delivery area is selected, the Work with Rep. Delivery Area detail (for the representative) is displayed (Figure 2-28).

```
Customers           Work with Rep. Delivery Areas            Databorough Ltd.
WWRAREAS                                                           16:51:06
                                                                 2005-09-16
 Rep. Code  . . . . . .    JKL
 Area Code  . . . . . .    NDL
 Area Description . . . .  Netherlands




F1=Help  F3=Exit  F12=Cancel
```

Figure 2-28 Work with Rep. Delivery Areas (display)

2.2.2 Data files associated with Customers Main Menu

The Customers Main Menu and its programs access and maintain the following data files (listed by file name and description):

- ASTATUS - Status File
- CONHDR - Contract Header
- CNPCNS - Contract Status
- CNPHSD - Contract Details
- CNPHST - Contract History
- CNPOPC - Contract Control
- CNTACS - Contacts
- CUSF - Sites
- CUSTS - Purchases
- CUTCLC - Customer Locations
- CUTCON - Customer Contacts
- CUTMST - Account Masters
- CUTSLM - Customer Tax Codes
- CUTSRI - Customer Requests
- DELIVA - Delivery Areas
- DELZON - Delivery Zones
- DISTS - Distributors
- LISTS - Lists
- NAMESIDX - Names Index
- ORGS - Organizations
- PTYPES - Products
- SECF - Security Codes
- SLMEN - Salespersons
- SLTXAR - Tax Details
- TRMDSC - Term Codes
- TRNHST - Transaction History

2.2.3 Programs associated with the Customers Main Menu

The CMS programs are located in the XRAPPS library. The list of CMS programs associated with the Main Menu are organized into three functional areas (Maintenance, Data Inquiry, and Utility). Each functional area and the associated programs are as follows:

- Maintenance functions
  - CUS002 Account Update
  - CUSFMAINT Customer Site Maintenance
  - CUSTFMAINTC Customer Site Maintenance
  - CUSFSEL Customer Site Selection
  - DSPDISTS Display Distributor
  - ORGMNT Organization Maintenance
  - RTNMSGTEXT Return Message Text
  - SMENSEL Salesmen Selection
- Data inquiry functions
  - WWCCONS Work with Customer Contacts
  - WWCCONSC Work with Customer Contacts
  - WWCUSF Work with Customer Sites
  - WWRAREAS Work with Rep. Delivery Areas
  - WWRAREASC Work with Rep. Delivery Areas

- Utility functions
  - XBCCLMSG Clear a Message Queue
  - XBCSNMSG Send Program Message
  - XCMMENU Customer System Main Menu
  - XMCSNMSG X-200: Send Program Message
  - Y2QLVNR YAPPOBJ Qualify a name, AS/400

2.3 The XRAPPS Library

The XRAPPS library contains the CMS application and extraneous data and source files.

2.3.1 Data files

Listed below are the data files in the XRAPPS library:

- ASTATUS - Status file
- CNPCNS - Contract status
- CNPHSD - Contract details
- CNPHST - Contract history
- CNPOPC - Contract control
- CNTACS - Contracts
- CONDET - Contract detail
- CONHDR - Contract header
- CUSF - Sites
- CUSGRP - Customer group
- CUSTS - Purchases
- CUTCLC - Customer locations
- CUTCON - Customer contracts
- CUTMST - Account masters
- CUTSLM - Customer tax codes
- CUTSRI - Customer requests
- DELIVA - Delivery areas
- DELZON - Delivery zones
- DISTS - Distributors
- GENTAB - Generic table file
- LISTS - Lists
- NAMESIDX - Names index
- ORGS - Organizations
- PRODFT - Project default steps
- PROJECT - Projects
- PROORDS - Profiled orders
- PROTRK - Project tracking
- PTYPES - Products
- SECF - Security codes
- SIPAPP - Receipts
- SIPMCT - Purchase headers
- SIPMDT - Purchase details
- SLMEN - Salespersons
- SLTXAR - Tax details
- SPPBCH - Batch processes
- SPPHCK - A/P check history
- SPPHLT - Contract master codes
- SPPOPC - Open invoices
- SPPVEN - Vendor masters

- SPPVRM - Vendor addresses
- SPPWKC - Supply headers
- SPPWKD - Supply details
- SPPWKH - Supply codes
- SPPWKN - Supply addresses
- STKBAL - Stock balances
- STKGRP1 - Stock group 1
- STKGRP2 - Stock group 2
- STKGRP3 - Stock group 3
- STKMAS - Product master
- STOMAS - Store master
- TRMDSC - Term codes
- TRNHST - Transaction history
- XFRF - Field reference file

2.3.2 Source and object files

Listed below are the programs in the XRAPPS library:

- CB906R - Back out Account
- CBC110 - Order Entry System
- CLET - Build Customer Letter
- CLETN - Print Customer Letter
- CNTCMAINT - Contracts Maintenance
- CON001 - Contract Entry
- CON100 - Contract Update
- CPDM - List Correspondence
- CSEC - Build Security Fax
- CSEC2 - Add Code to Batch
- CSEC3 - Agent Fax Prompt
- CUS002 - Account Update
- CUSCPY - Customer Copy
- CUSFMAINT - Customer Site Maintenance
- CUSFMAINTC - Customer Site Maintenance
- CUSFSEL - Customer Site Selection
- CUSINIT - Initialize Customer Record
- CUSLET - Customer Letter - Stage 1
- CUSLET1 - Customer Letter - Stage 2
- CUSLETSQ - Update Letter Sequence
- CUSLIBS - Customer Library Settings
- CUSMNU - Customer Menu
- CUSMTH - Update Maintenance Months
- CUSRGZ - Reorganize Customer File
- DLYFAXSHT - Delayed Faxshot
- DREPORT - Distributor Report
- DSPDISTS - Display Distributor
- DSPPTYPES - Display Product
- FAXERR1 - Faxshot Errors Part 1
- FAXERR2 - Faxshot Errors Part 2
- FAXNOS1 - Generate Fax Numbers
- FAXSHT - Immediate Faxshot
- FAXSHT1 - Generate Fax Shots
- FXS1C - Special Faxshot
- FXS3C - Report/Resize Faxshot Errors
- GCNTAC1 - Generate Prospect Record
- GCUST1 - Generate Purchase Record

- GETDCOD - Find Customer Distributor Code
- LETN1 - Letter Prefix Generation
- OE001 - Order Entry
- OE002 - Order Inquiry
- 0E003 - Product Inquiry
- OE004 - Customer Inquiry/Maintenance
- OE006 - Print Invoices
- OE008 - Order Entry
- OEMENU - Order Entry Menu
- ORGMNT - Organization Maintenance
- PROFIX1 - FIX Project Details
- PUR01 - Purchase Order Entry
- RTNMSGTEXT - Return Message Text
- SEC1 - Security Code Report
- SECFCPY - Security Code Copy
- SECFO - Reorganize Codes Files
- SECFOCLP - Security Report
- SMENSEL - Salesmen Selection
- WKCUS8E - Customer Release Letter
- WKCUS8EF - Find Fax Number
- WKCUS8P - Customer Inquiry Letter
- WKCUSL - Customer Letter
- WKCUSLC - Choice Program for WKCUSL
- WKCUSLV - Validity Checker for WKCUSL
- WKCUSP - Summary Customer Report
- WKSECF6 - Generate CPU Letter
- WKSECF6B - Fax CPU Details
- WKSECF6B2 - Distributor Security Code Fax
- WKSECF6B3 - Send Distribution Fax
- WKSECFC - Security Audit
- WWCCONS - Work with Customer Contacts
- WWCCONSC - Work with Customer Contacts
- WWCUSF - Work with Customer Sites
- WWRAREAS - Work with Rep. Delivery Areas
- WWRAREASC - Work with Rep. Delivery Areas
- X@GSCD - Generate Code
- XACBLTST - COBOL Test Program
- XAN4CDEMIZ - Initialize Additional Parts for Demo
- XAN4CDEMNW - Initialize Additional Parts for Demo
- XASYSOPR - XA - Test Alert
- XBCCLMSG - Clear a Message Queue
- XBCSNMSG - Send Program Message
- XCMMENU - Customer System Main Menu
- XCRTPF - Recreate a Physical File
- XMCSNMSG - X-2000; Send Program Message
- XRATE_EURO - Euro conversion Calculation
- Y2QLVNR - YAPPOBJ Qualify a Name AS/400
- ZACUSF - ZACUSF Shadow Program
- ZACUSTS - ZACUSTS Shadow Program

3

Re-engineering an existing application to the MVC architecture

This chapter demonstrates how to use X-Analysis to Web-enable an existing display application by re-engineering it to the Model-View-Controller (MVC) architecture. The chapter explains the concepts behind the MVC re-engineering process and provides an example of how the re-engineering is performed.

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3.1 Prerequisites for MVC re-engineering

X-Analysis consists of a foundation product and a number of extensions. The X-Analysis foundation and the following extensions are required for the re-engineering process:

- X-Rev
- X-Migrate
- X-Extract
- X-Browse

The X-Web server is also packaged with X-Analysis. This product is also required for this re-engineering process.

You must perform certain installation and configuration steps prior to starting the MVC re-engineering process:

1. Install X-Analysis on the iSeries hosting the target application.

   For information about installing X-Analysis on the iSeries, refer to “Installing X-Analysis on the iSeries” on page 243.

2. Install IBM WebSphere® Development Studio Client for iSeries (WDSc) on your PC in order to implement the Web-enabled application as JavaServer Faces.

   Note: WDSc is not required to run the MVC re-engineering process and Web-enable the application. It is required to complete the final optional step of implementing the Web-enabled application in JavaServer Faces.

   For more detailed information about installing WDSc on the client PC, refer to *WebSphere Development Studio Client for iSeries Version 5.1.2*, SG24-6961.

3. Install the X-Analysis client on your PC. You use the X-Analysis client to perform the application re-engineering.

   Note: If WDSc is being used, it must be installed prior to the X-Analysis client so that the X-Analysis will properly register its WDSc plug-in on installation.

   To install the X-Analysis client on your PC, refer to “Installing X-Analysis client” on page 243.

4. Load the Customer Management System (CMS) sample application on the iSeries.

   For more detailed information about loading the sample application on the iSeries, refer to “Loading the Customer Management System on the iSeries” on page 247.

5. Create a cross-reference repository for the CMS application on the iSeries. The repository is stored in an iSeries application library. This library identifies to X-Analysis the source, object, and data libraries used by the application.

   Important: The example in this chapter assumes that the X-Analysis cross-reference application library is created with the name *CMS*, not “CMSXV1” as shown in the instructions.

   To create a cross-reference repository for the CMS application in X-Analysis, refer to “Creating a cross-reference repository for the Customer Management System” on page 247.

6. Build the data model. You use this data model as the basis for the View and Controller components of the re-engineering application.

   To build a data model, refer to “Generating the data model for the Customer Management System” on page 251.

7. Obtain designer authority to the cross-reference repository, so you can perform the application re-engineering.

   For information about granting authorities in X-Analysis, refer to “Giving designer authority” on page 252.

8. Install X-Web server on the client PC.

   A major aspect of our application re-engineering is Web-enabling the application. To test and run the new Web-enabled application, you must install the X-Web server on your PC.

   For more detailed information about installing the X-Web Server on your PC refer to “Installing the X-Web Server and Apache Tomcat” on page 254.

9. Verify authority to the application library Web site in X-Web.

   You must have authority to your application Web site in X-Web. This may have been created when you were granted authority to the cross-reference repository. If not, you must grant yourself access manually.

   To manually grant access to the CMS application library Web site, perform the following steps:

   a. Sign on to your iSeries and gain access to a command line.

   b. Enter this command:

      ```
      upddta cms/xmbrinfo
      ```

   c. Select F10 (Entry).

   d. Enter a new record with the following information:

      i. Enter your iSeries user ID in the USERNAME field.

      ii. Enter `*SYSTEM in` the PASSWORD field.

      iii. Enter `N` in the HELPDF field.

      iv. Enter your iSeries user ID in the USRPRF field.

   e. Press Enter.

3.2 Application re-engineering overview

In this chapter, we demonstrate the methodology of Web-enabling an existing display application by re-engineering it into the MVC architecture.

3.2.1 The Model-View-Controller architecture

Model-View-Controller is the Java BluePrints recommended architectural design pattern for interactive applications. MVC organizes an interactive application into three separate components, as shown in Figure 3-1 on page 38:

- Model (includes data representation and business logic)
- View (provides data presentation and user input)
- Controller (dispatches requests and controls flow)

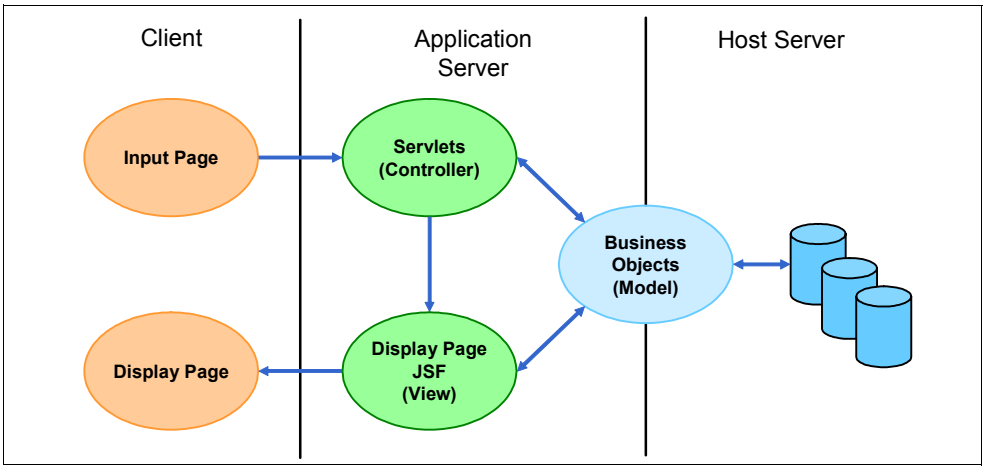

Figure 3-1 MVC architecture

Most Web-tier application frameworks use some variation of the MVC design pattern. Additional information about MVC architecture is available at:

`http://java.sun.com/blueprints/patterns/MVC.html`

In our resulting application, the View and Controller portion of the design run on the application server (located on the iSeries), and the Model component runs on the iSeries. The Model component is invoked by the Controller when business logic is required.

3.2.2 Creating the Model

The existing application display programs contain business logic used to control areas such as screen setup, entry validation, and post display processing. When the X-Analysis MVC re-engineering process creates the Model component, it performs the following steps:

1. Examines the existing application's data model and display programs
2. Extracts the business logic from the display programs
3. Casts the business logic into a set of business rules
4. Implements the business rules as a set of stored procedure programs

Each resulting stored procedure program consists of a sequence of business rules described in English and implemented in RPG. These stored procedures form the Model component of the MVC architecture.

Note: If the original application program called other non-interactive programs to perform business rule processing, the resulting stored procedures will call these programs as well. These "batch" programs are not affected by the MVC re-engineering process.

3.2.3 Creating the View and Controller

When X-Analysis builds its data model for the existing application, it examines the structure of the model and creates a database of display and flow of control information on the iSeries. The X-Analysis MVC re-engineering process enhances this database with additional information drawn from the existing application's program logic and display file layouts. The resulting metadata for each individual view is grouped into packages called *function definitions*.

A function definition contains data regarding:

- Presentation of the user interface (the window layout)
- Necessary data access methods for the View
- Database driven validations and selections
- When the business rule code from the Model program is invoked
- Navigation from its view to other views

These function definitions are used by either a Web browser user interface or rich client user interface to implement the View-Controller components of the re-engineered application.

Note: View, Model, and Controller, when capitalized, refer to View, Model, and Controller from MVC architecture.

Web browser user interface

There are two separate methods we can use to implement a Web browser user interface using the function definitions:

- The application can be run under the X-Web framework on the application server. The X-Web framework implements the Controller, and accesses the function definition layout information at run time to dynamically build the Views as needed. The Views are accessed by a Web browser on the client PC.
- The X-Analysis JSF Generator can use the function definitions to generate a Web project consisting of Java class files, JavaServer Faces (JSF), and JavaBeans. The Java components can then be run either with or without the X-Web framework. The application server uses the generated JavaServer Faces to implement the Views. The Views are accessed by a Web browser on the client PC.

Rich client user interface

Under the rich client implementation, the X-Browse extension acts as a rich client running on the PC. X-Browse implements the Controller function and uses the function definitions to dynamically build the resulting View.

The X-Analysis client uses the rich client interface to implement its function definition editor. When we use the function definition editor in 3.6.1, “Viewing the standard function definitions” on page 47, you see an example of the rich client implementation. However, since the focus of this chapter is on developing the Web browser user interface, we do not further discuss the rich client user interface.

Model access

Regardless of how the View-Controller is implemented, the execution of the Model is the same. All three Controller implementations call the same stored procedures that were built on the iSeries. Only the call methodology varies.

3.2.4 Working with function definitions

Function definitions are generated automatically by X-Analysis. However, some design work tuning the automatically generated function definitions is usually required to achieve the desired application. This design work can include:

- Modifying or enhancing the window layouts
- Modifying or enhancing the links to other windows
- Modifying or enhancing the stored procedure calls
- Modifying or enhancing the window functionality (add, display, change, delete)

Design and editing of the automatically generated function definitions is done with the Function Definition Editor in the X-Analysis client. You use this tool to change and enhance both the View (window layout) and the Controller (screen links and Model calls) components of the resulting application.

Types of function definitions

Each function definition falls into one of six types, based on its View format:

- *Grid Functions* (Type A) are used to display a group of records and their fields. Grid functions serve the same purpose as a subfile in a display application, where a group of records is displayed and the user selects one for more detail.
- *Flat Screen Functions* (Type Z) are used to display a single record. The Z function displays the record in a format based on the data model.
- *Drop Down Selection List Functions* (Type D) are used when the user can select between a distinct number of options.
- *Prompt Functions* (Type P) are used when a prompt window is needed for a small set of fields.
- *5250 Functions* (Type U) are used to display a single record. The U function displays the record in the same layout as the existing application.
- *List Functions* (Type W) are used to display a list of selections.

Categories of function definitions

X-Analysis divides function definitions into two categories based on how they are created:

- *Standard function definitions (SFDs)* are built when the data model is created. SFDs are built directly from the database of the existing application, using the data model relationships to control cross-file validation and navigation. SFDs tie directly to physical files, and can be used for file maintenance and display, as well as providing searchable grids and general purpose reports. After the data model for an application is created, X-Analysis automatically creates the SFDs of the appropriate types for each physical file in the application based on the application data model.
- *Re-engineered function definitions (RFDs)* are built when the MVC re-engineering process is run. RFDs are generally less standardized because they are generated from both the data model and the existing application code. The View information contained in an RFD more closely resembles the existing application display screens. Navigation links in the RFD closely correspond to the function keys that are available in the source display program. To execute business logic such as validation, RFDs are automatically built with a connection to the appropriate stored procedures. X-Analysis creates Grid Function and Flat Screen Function RFDs from the existing application's RPG code and display files when the MVC re-engineering process is run.

3.3 Example application

A section of the Customer Management System (CMS) application (defined in Chapter 2, "Introducing the sample application" on page 15) is used to demonstrate the X-Analysis MVC re-engineering process. X-Analysis enables a large application to be divided into logical partitions called *application areas*. For this example, we place the Customer Service display programs into a separate application area, and work primarily with these programs.

For the selected section of the Customer Management System, we show how X-Analysis replaces the existing application's RPG display programs with a new Web-enabled presentation layer re-engineered into the Model-View-Controller architecture.

3.4 X-Analysis MVC re-engineering summary

Like most large tasks, the MVC re-engineering process is broken down into a number of discrete steps, which consist of:

1. Partitioning the application. You identify the section of the application you are re-engineering, create an application area, and assign the application section to the application area.
2. Review the standard function definitions. You identify the SFDs in the application area and review their format layouts using the function definition editor.
3. Customize the standard function definitions. You identify the changes needed to fit the application requirements and update the SFDs using the function definition editor.
4. Run the X-Analysis MVC re-engineering process. This generates the business rules from the application code, then generates the stored procedures from the business rules, and finally generates RFDs from the application code, display files, and database.
5. Review the re-engineered function definitions. You identify the RFDs in the application area, and review their format layouts using the function definition editor.
6. Review the re-engineered stored procedures. You identify the stored procedures in the application area, view the business rules contained in the stored procedures, and review the links between the function definitions and the stored procedures.
7. Customize the re-engineered function definitions. You identify the changes needed to fit the application requirements and update the RFDs using the function definition editor.
8. Implement the Web-enabled application using the X-Web framework. You start and configure the X-Web server, and use the X-Web server to run the Web-enabled application.
9. Implement the Web-enabled application in Java. You create Java components with the X-Analysis client, and then modify them using WDSc. You run the resulting Java application using the X-Web framework on the X-Web server.
10. Review the JSF, JavaBean, and stored procedure code. You review the call path between the JSF displayed in the Web browser, and the stored procedures on the iSeries.

Note: In actual practice, there is some flexibility to the order in which these steps are executed. For example, the MVC re-engineering process can be run immediately after logically separating the application. The SFDs and RFDs would then be reviewed and customized together. Also, if the desired end result is running the Web-enabled application using JSF, the step of running the Web-enabled application in the X-Web framework could be bypassed.

3.5 Partitioning the application

The partition of the CMS system we work with is the display programs most used by the Customer Service area. These display programs are all accessed from the Customers Main Menu (Figure 3-2 on page 42). Our partition includes the menu and all of the screen display programs directly or indirectly available from that menu.

The RPG program XCMMENU implements the Customers Main Menu.

```
Customers              M A I N   M E N U                    Databorough Ltd.
XCMMENU                                                            15:29:27
                                                                2005-09-09

Select one of the following:

          1.  Customer Site Maintenance
          2.  Organisation Maintenance
          3.  Account Maintenance
          4.  Work with Customer Contacts
          5.  Work with Customer Sites
          6.  Work with Rep. Delivery Areas


Option:

F3=Exit  F12=Cancel  F21=Command line
```

Figure 3-2 Customers Main Menu

For more information about the Customers Main Menu and its options, refer to 2.2.1, “Customers Main Menu” on page 16.

For more detailed information about using X-Analysis to divide an application into application areas, refer to 5.3, “Application areas” on page 197.

3.5.1 Creating the application area

In the X-Analysis client, locate the CMS cross-reference repository (named CMS) in the Application Libraries list in the left pane of the X-Analysis client.

To create the application area, follow these steps:

1. Right-click **CMS**. Select **New Application Area** from the pop-up menu.
2. In the Add Application Area dialog box (Figure 3-3), specify the application area name and description:
   a. Enter `CUSTSYS` for the Name field.
   b. Enter `Customer System Main Menu` for the Description field.

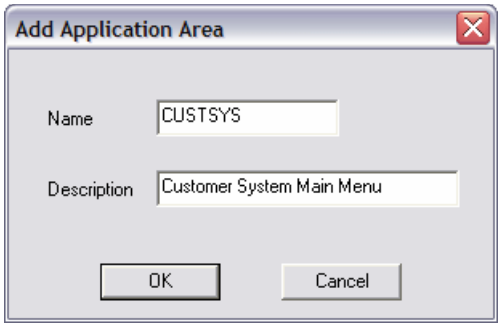

Figure 3-3 Add application area dialog box

3.5.2 Adding the Customers Main Menu to the application area

In the X-Analysis client, perform the following steps to assign the Customer Service menu and the programs it calls to the new CUSTSYS application area:

1. Locate and expand the CMS cross-reference repository (named CMS) in the Application Libraries list in the left pane of the X-Analysis client.
2. In the expanded CMS cross-reference repository, double-click **Programs**.
3. In the Work with Objects dialog box, click **OK**.
4. From the resulting list, right-click **XCMMENU** and select **Add to Application Area with Related Objects** (Figure 3-4).

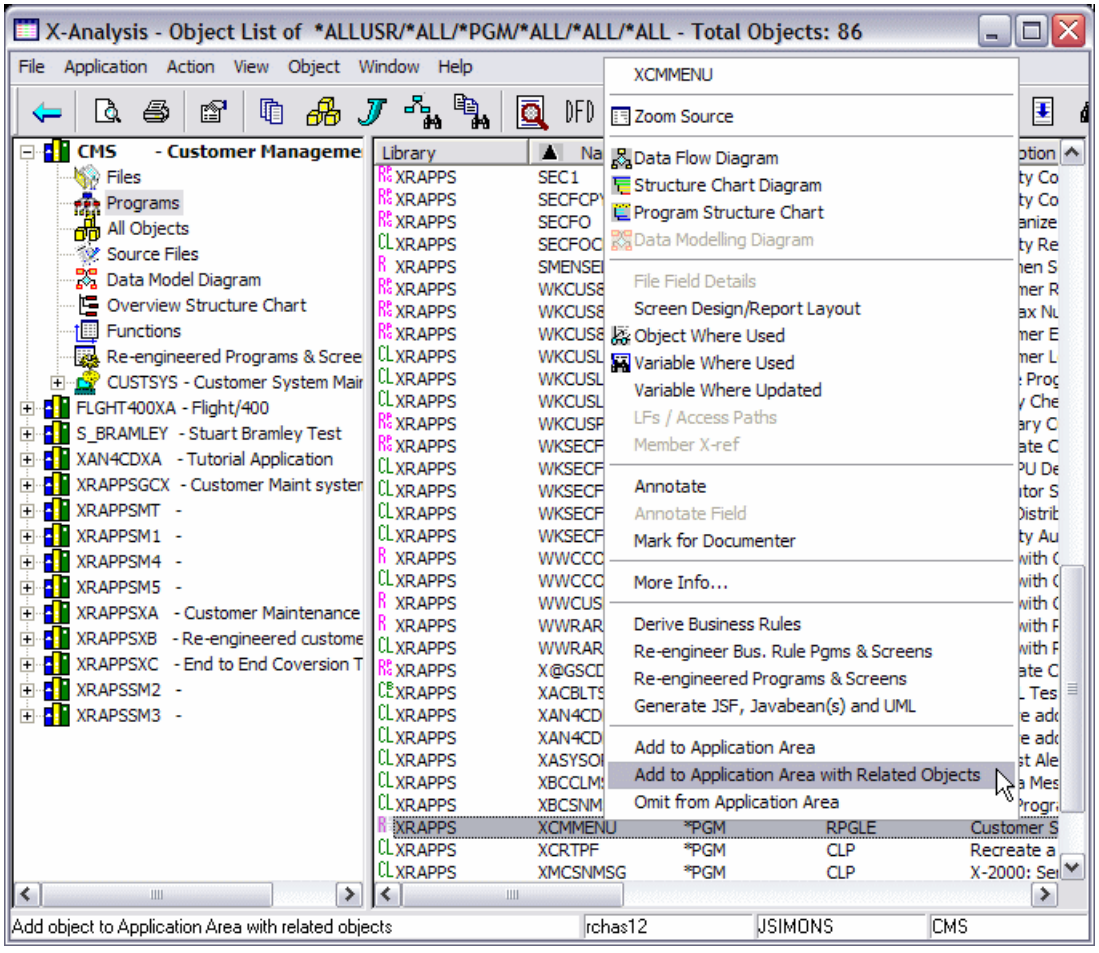

Figure 3-4 XCMMENU selection

5. In the Add XCMMENU to Application Area with Related Objects dialog box (Figure 3-5), perform the following steps:
   a. Select the **CUSTSYS** application area.
   b. Select **Include the files referenced by program** from the first pull-down list.
   c. Select **Include complete stack of programs called** from the second pull-down list.
   d. Select **Include files referenced by any included program** from the third pull-down list.

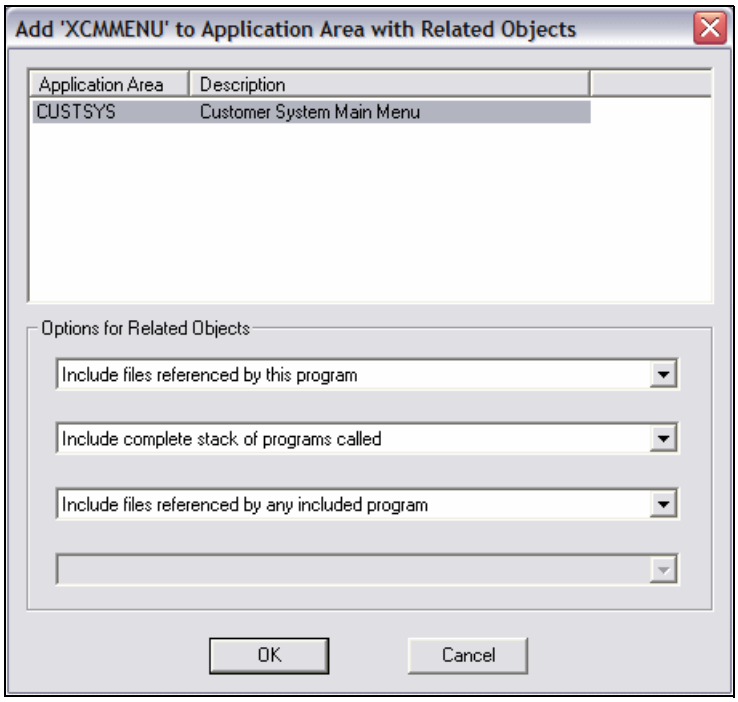

Figure 3-5 Add XCMMENU to Application Area with Related Objects

   e. Click **OK**.
   f. The completion message `Object and its related objects added to Application area` appears in the X-Analysis client status bar located at the bottom of window.

3.6 Reviewing the application's standard function definitions

Figure 3-6 shows how X-Analysis creates the data model and standard function definitions. The X-Analysis data modeling program extracts the data model from the existing application's program code and database. Then the X-Analysis Function Builder uses this data model to build a set of SFDs for each of the physical files in the application.

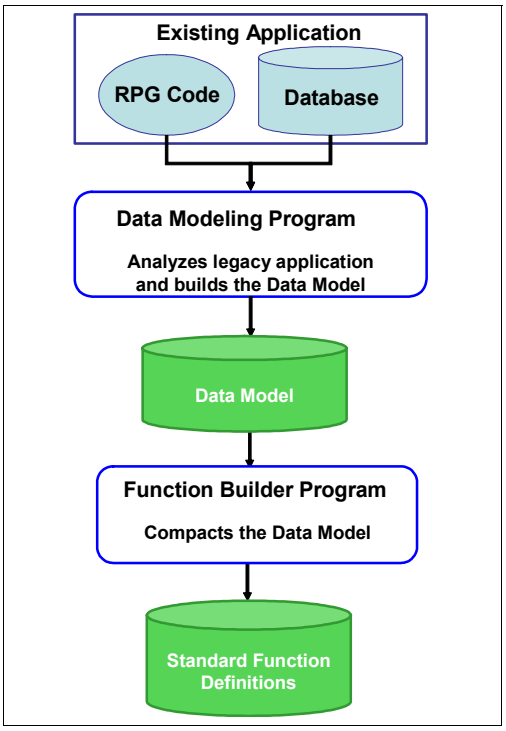

Figure 3-6 X-Analysis standard function definition generation

These SFDs focus on providing view and controller information related to the display and maintenance of the application's physical files. In some cases, these SFDs contain all View and Controller functionality needed for that file in the final re-engineered application.

3.6.1 Viewing the standard function definitions

To view the function definitions in the X-Analysis client, perform the following steps:

1. In the left pane of the X-Analysis client window, locate and expand the **CUSTSYS** application area under the CMS cross-reference repository.
2. In the expanded CUSTSYS application area, double-click **Functions**.
3. In the Work with Objects dialog box, click **OK**.
4. The function list for the CUSTSYST application area appears in the right pane of the X-Analysis client.

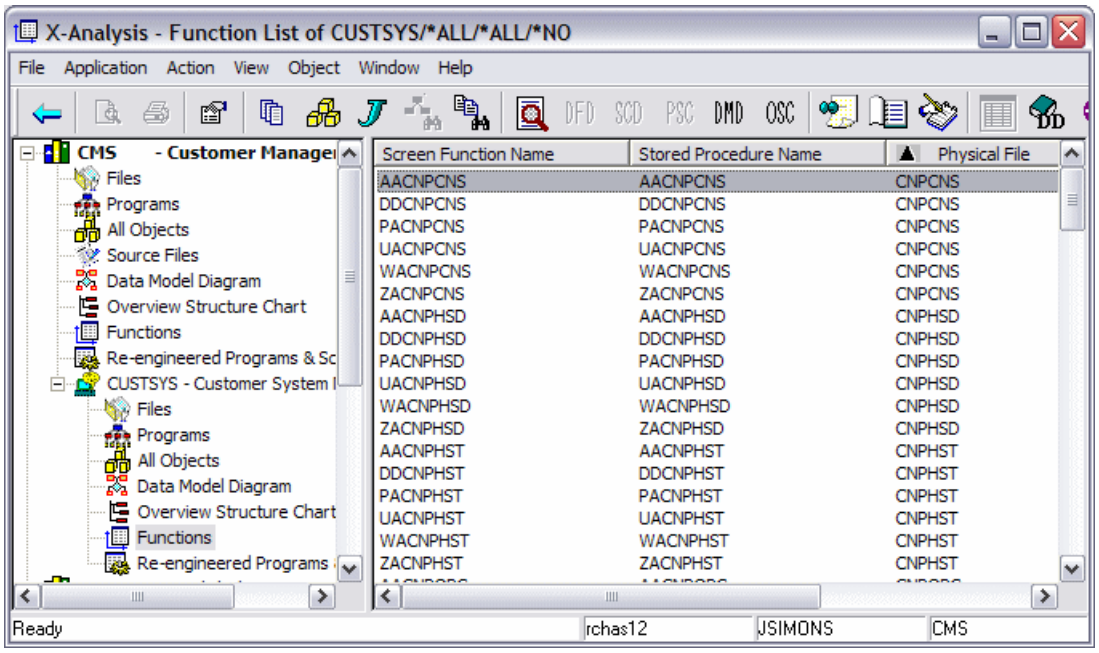

Figure 3-7 CUSTSYS application area standard functions

3.6.2 Standard function definition naming conventions

Every X-Analysis function definition has a unique function name that is assigned automatically when it is generated. X-Analysis adopts a specific naming convention for standard function definitions that distinguish the type of the function and the associated physical file.

The default SFD name consists of two parts:

1. A two-letter identifier based on the function type:
   - AA for Grid Functions (Type A)
   - DD for Drop Down Functions (Type D)
   - PA for Prompt Functions (Type P)
   - UA for 5250 Style Functions (Type U)
   - WA for List Functions (Type W)
   - ZA for Flat Screen Functions (Type Z)
2. The physical file name

As an example, the Grid SFD for the physical file CUSTF is AACUSTF. The Flat Screen SFD for the same physical file is ZACUSTF.

Tip: In the X-Analysis client, the SFDs are listed in the first column of the Function List View under the heading *Screen Function Name*. Their associated physical file is listed in the third column under the heading *Physical File*.

3.6.3 Associated stored procedures

By default, every X-Analysis SFD contains a link to a stored procedure. Stored procedures hold the business rules associated with the function definition. When you use the Function List View in the X-Analysis client, the stored procedures appear beside their associated function definitions. Stored procedures are discussed in more detail later under MVC re-engineering. (See 3.10, “Reviewing the re-engineered stored procedures” on page 70).

Note: These SFDs were built entirely from the data model, so they do not have specific business rules associated with them at this point in the re-engineering process. X-Analysis links each SFD to a “placeholder” stored procedure, which it assigns the same name as the SFD. While these links show on the Function View list of the X-Analysis client, the Function Builder does not create an actual empty stored procedure source member in the cross-reference library. Therefore, when you attempt to view the stored procedure source, you receive the message `Source Member not found in this cross-reference library`.

3.6.4 Displaying the function layout

Each standard function definition contains information about how a physical file should be displayed to the user. The X-Analysis client contains the function definition editor, which lets you review and modify the automatically generated function layouts.

For this example, two of the SFDs for the CMS application’s Contact file (CNTACS) are reviewed:

- AACNTACS - The Grid SFD for the Contacts File
- ZACNTACS - The Flat Screen SFD for the Contacts File

The Contacts file is assigned to the CUSTSYS application area because the Customers Main Menu option 4 gives access to the Work with Customer Contact display program. (Figure 2-16 on page 24). The Work with Customer Contract program is used to display the Contacts file.

Attention: The CMS application contains both a Contacts (CNTACS) and a Customer Contacts (CUTCON) file. Despite its menu and screen titles, the Work with Customer Contact display program is actually used to provide access to the Contact file, not the Customer Contact file.

The Grid SFD for the Contacts file

To display the layout for this function definition:

1. Locate and right-click **AACNTACS** under Screen Function Name in the Function List View of the X-Analysis client.

   Tip: When you are trying to locate a function from a large list, do the following:

   1. Click the **Physical File** column header to sort the list by file name.
   2. Locate the set of functions for your physical file.
   3. Select your specific function from that set.

2. Select **Function Layout**.

   The window display for the AACNTACS function definition (Figure 3-8 on page 48) appears. The AACNTACS Grid display shows the records from the Contacts file in a table layout. You can scroll through the file, or double-click on a record to select it. A Grid SFD provides functionality similar to a standard subfile selection screen in a display application,

but it removes many of the subfile limitations while adding additional features and functionality.

X-Browse - Contacts
File View LookupBy Actions Dependents Filters Design Help
logged in as JSIMONS Tue, Sep 13, 2005 AD at 15:09:30
Contract Control Contract History Customer Groups Distributors Lists Names Index Organisations Products Project Default Steps Status file
Cus. No. Prod Code Contact Email Sales Person Sts Phone Fax.No.
0 XA Charlie Brown charliebrown@databorough.com A 01 98735 7799 01 98735 4444
1 XC S
5 XB A
59 XA Stuart Williams stutex@mymail.com 1 0456 182 234 0456 182 246
59 XA Neil Partridge neil@acorn.co.uk 2 0456 182 234 0456 182 246
59 XA Jane Freemantle janef@acorn.co.uk 3 0456 182 234 0456 182 246
59 XA Mark Rolls mark@homeware.co.uk 4 0456 182 234 0456 182 246

Figure 3-8 AACNTACS function layout

The Flat Screen SFD for the Contacts file

To display the layout for ZACNTACS Flat Screen SFD display, double-click any of the table entries in the AACNTACS Grid SFD display. Alternately, you can close the Grid SFD display and take the following steps:

1. Locate and right-click **ZACNTACS** under Screen Function Name in the Function List View of the X-Analysis client.
2. Select **Function Layout**.

The window display for the ZACNTACS function definition (Figure 3-9) appears. The ZACNTACS Flat Screen SDF shows the individual record from the Contacts file.

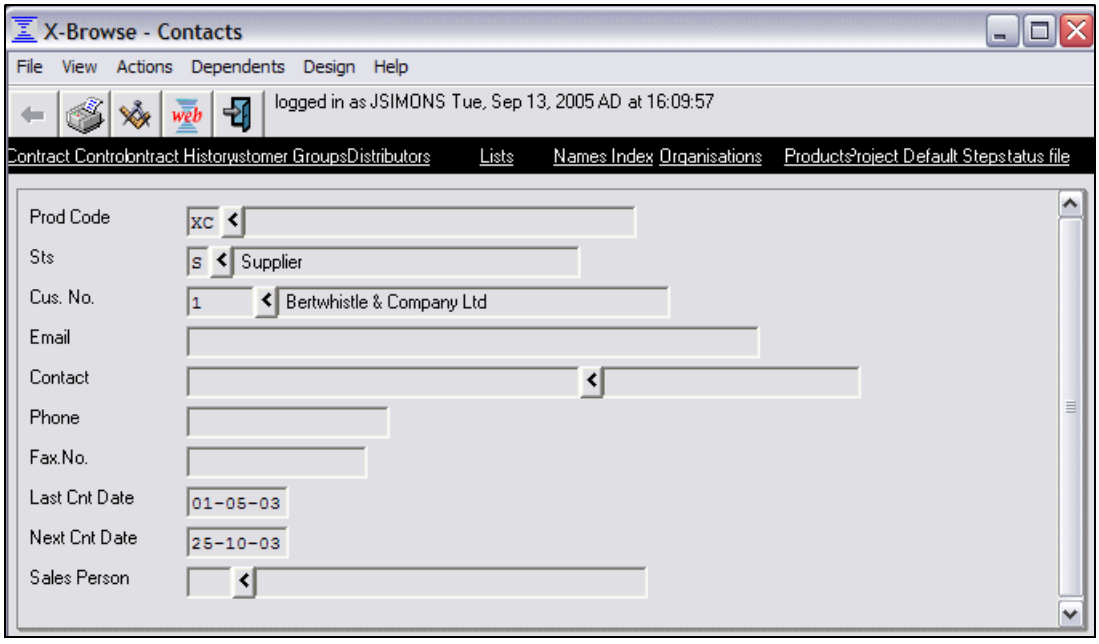

Figure 3-9 ZACNTACS function layout

This Flat Screen SFD provides the same basic functionality as the existing single-record display in the CMS Work with Customer Contacts display program (Figure 3-10). In addition, it contains the added functionality to automatically supply matching values from the associated tables for the Product Code, Status, Customer Number, and Salesperson fields.

```
Customers            Work with Customer Contacts             Databorough Ltd.
WWCCONS                                                              15:32:07
                                                                    2005-09-13

 Customer No  . . . . .    00001
 Product Code . . . . .    XC
 Contact  . . . . . . . .
 Telephone No . . . . . .
 Fax No . . . . . . . . .

 Last Contact Date  . . .  2003-05-01
 Next Contact Date  . . .  2003-10-25
 Salesperson  . . . . . .
 Status . . . . . . . . .  S
```

Figure 3-10 Work with Customer Contacts single record display

Attention: While the ZACNTACS function layout is visually very similar to the layout of the existing application's Work with Customer Contact screen (Figure 3-10), the WWCCONS display file was *not* used by X-Analysis to develop the ZACNTACS standard function definition. Standard function definitions come entirely from the data model, and do not reference the actual display file or application logic.

3.7 Customizing the standard function definitions

While reviewing the SFDs, you observed that the functions AACNTACS and ZZCNTACS meet all the basic requirements of the CMS Work with Customer Contacts display program. Each SFD requires minor customization to more closely match the existing application display programs. After customization, these SFDs are used in the re-engineered application to provide the functionality of the Work with Customer Contacts menu option.

3.7.1 Customizing the Grid SFD

To customize the Grid SFD AACNTACS, follow these steps:

1. In the left pane of the X-Analysis client window, locate and expand the **CUSTSYS** application area under the CMS cross-reference repository.
2. In the expanded CUSTSYS application area, double-click **Functions**.
3. In the Work with Objects dialog box, click **OK**. The function definition list for the CUSTSYST application area appears in the right pane of the X-Analysis client.
4. Locate and right-click **AACNTACS** under Screen Function Name in the Function List View of the X-Analysis client.
5. Select **Function Layout**. The window layout for the AACNTACS SFD appears (Figure 3-8 on page 48).
6. Click the Function Designer button on the toolbar.

Tip: If the Function Designer button is inactive (gray) on your window, then you do not have design authority for this application in X-Analysis. For information about how to give yourself design authority, refer to “Giving designer authority” on page 252.

7. The function definition editor opens in the lower pane of your window (Figure 3-11). Click the **Function Menu** tab to modify the links.

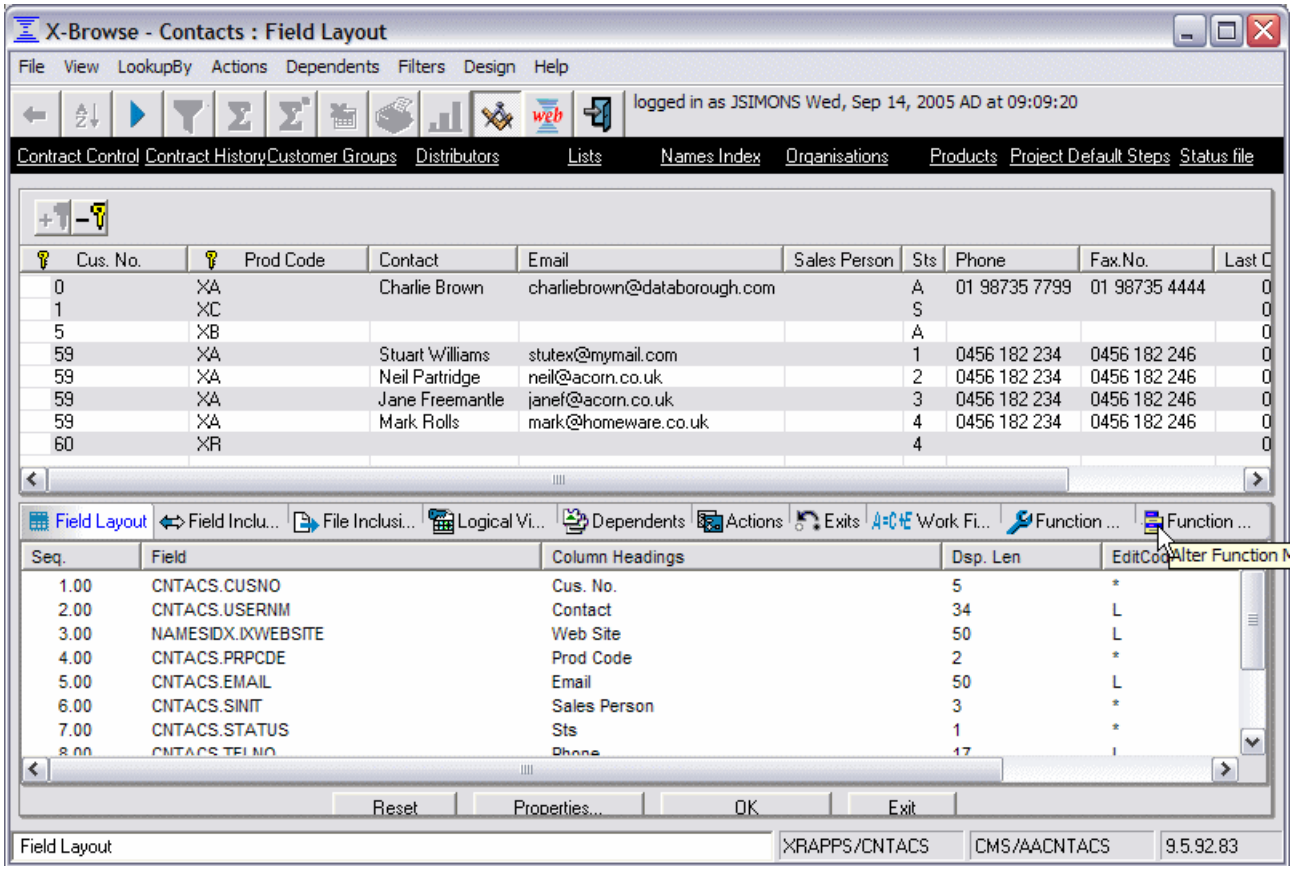
X-Browse - Contacts : Field Layout
File View LookupBy Actions Dependents Filters Design Help
logged in as JSIMONS Wed, Sep 14, 2005 AD at 09:09:20
Contract Control Contract History Customer Groups Distributors Lists Names Index Organisations Products Project Default Steps Status file
Cus. No. Prod Code Contact Email Sales Person Sts Phone Fax.No. Last C
0 XA Charlie Brown charliebrown@databorough.com A 01 98735 7799 01 98735 4444 0
1 XC S 0
5 XB A 0
59 XA Stuart Williams stutex@mymail.com 1 0456 182 234 0456 182 246 0
59 XA Neil Partridge neil@acorn.co.uk 2 0456 182 234 0456 182 246 0
59 XA Jane Freemantle janef@acorn.co.uk 3 0456 182 234 0456 182 246 0
59 XA Mark Rolls mark@homeware.co.uk 4 0456 182 234 0456 182 246 0
60 XR 4 0
Field Layout Field Inclu... File Inclusi... Logical Vi... Dependents Actions Exits Work Fi... Function ... Function ...
Alter Function M
Seq. Field Column Headings Dsp. Len EditCo
1.00 CNTACS.CUSNO Cus. No. 5 *
2.00 CNTACS.USERNM Contact 34 L
3.00 NAMESIDX.IXWEBSITE Web Site 50 L
4.00 CNTACS.PRPCDE Prod Code 2 *
5.00 CNTACS.EMAIL Email 50 L
6.00 CNTACS.SINIT Sales Person 3 *
7.00 CNTACS.STATUS Sts 1 *
Reset Properties... OK Exit
Field Layout
XRAPPS/CNTACS
CMS/AACNTACS
9.5.92.83

Figure 3-11 Format AACNTACS in the function definition editor

8. Remove the undesired links:
   a. Locate the **Caption** column in the Function Menu tab.
   b. Select the check box in the **Delete** column (Figure 3-12) beside each of these items:
      - Contract Control
      - Contract History
      - Customer Group
      - Distributors
      - List
      - Name Index
      - Organizations
      - Project Default Steps
   c. Click **OK**.

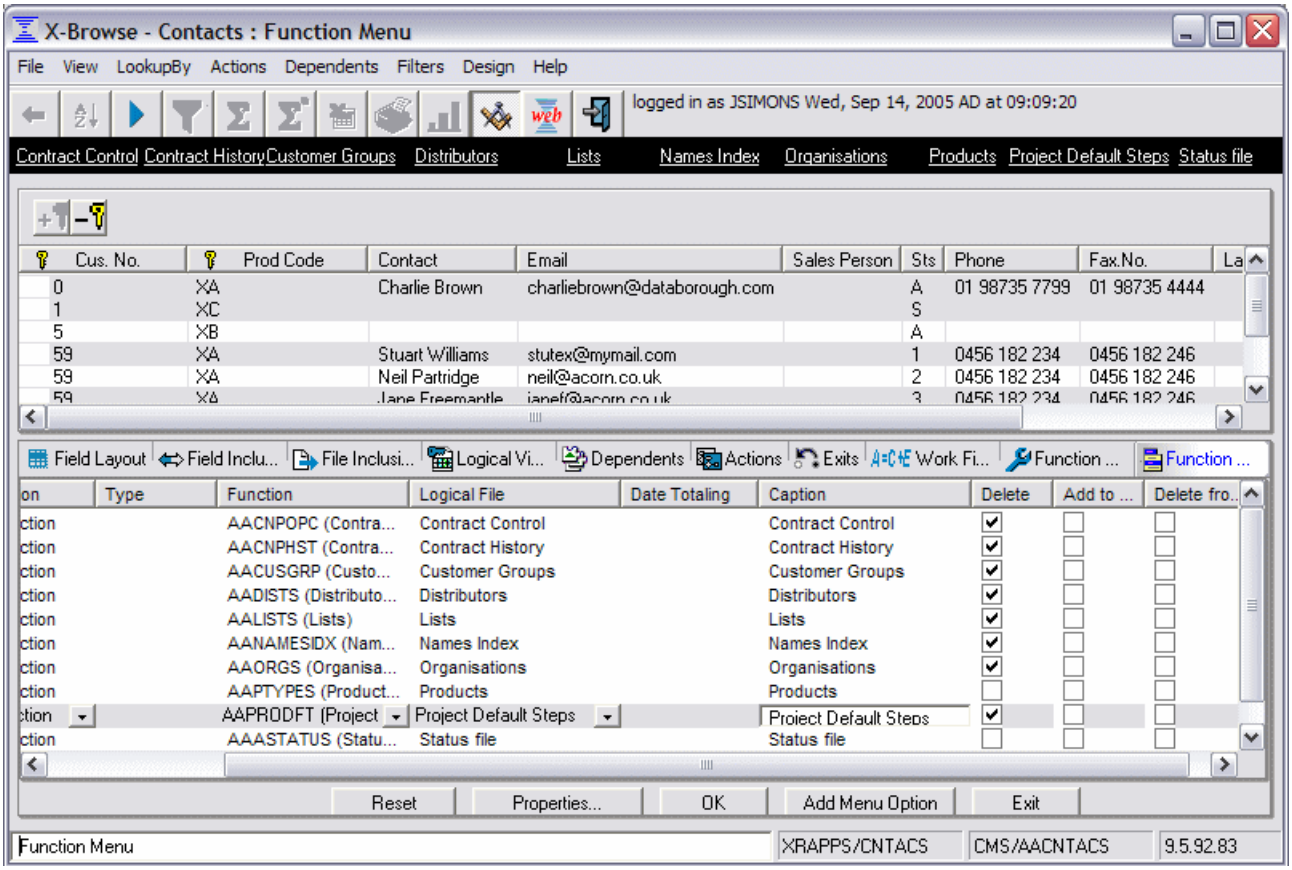
X-Browse - Contacts : Function Menu
File View LookupBy Actions Dependents Filters Design Help
logged in as JSIMONS Wed, Sep 14, 2005 AD at 09:09:20
Contract Control Contract History Customer Groups Distributors Lists Names Index Organisations Products Project Default Steps Status file
Cus. No. Prod Code Contact Email Sales Person Sts Phone Fax.No.
0 XA Charlie Brown charliebrown@databorough.com A 01 98735 7799 01 98735 4444
1 XC S
5 XB A
59 XA Stuart Williams stutex@mymail.com 1 0456 182 234 0456 182 246
59 XA Neil Partridge neil@acorn.co.uk 2 0456 182 234 0456 182 246
Field Layout Field Inclu... File Inclusi... Logical Vi... Dependents Actions Exits Work Fi... Function ... Function ...
on Type Function Logical File Date Totaling Caption Delete Add to ... Delete fro...
ction AACNPOPC (Contra... Contract Control Contract Control
ction AACNPHST (Contra... Contract History Contract History
ction AACUSGRP (Custo... Customer Groups Customer Groups
ction AADISTS (Distributo... Distributors Distributors
ction AALISTS (Lists) Lists Lists
ction AANAMESIDX (Nam... Names Index Names Index
ction AAORGS (Organisa... Organisations Organisations
ction AAPTYPES (Product... Products Products
ction AAPRODFT (Project Project Default Steps Project Default Steps
ction AAASTATUS (Statu... Status file Status file
Reset Properties... OK Add Menu Option Exit
Function Menu
XRAPPS/CNTACS
CMS/AACNTACS
9.5.92.83

Figure 3-12 Deleting links in format AACNTACS

9. Add the Salesperson link:
   a. Click **Add Menu Option**.
   b. In the Add Menu dialog box (Figure 3-13):
      i. Select **Function** from the Action pull-down list.
      ii. Select **AASLMEN (SalesPersons)** from the Function pull-down list.
      iii. Select **Salespersons** in the Logical File pull-down list.
      iv. Enter `Sales Persons` in the Caption field.
   c. Click **OK**.
   d. In the Menu Properties dialog box, click **OK**.

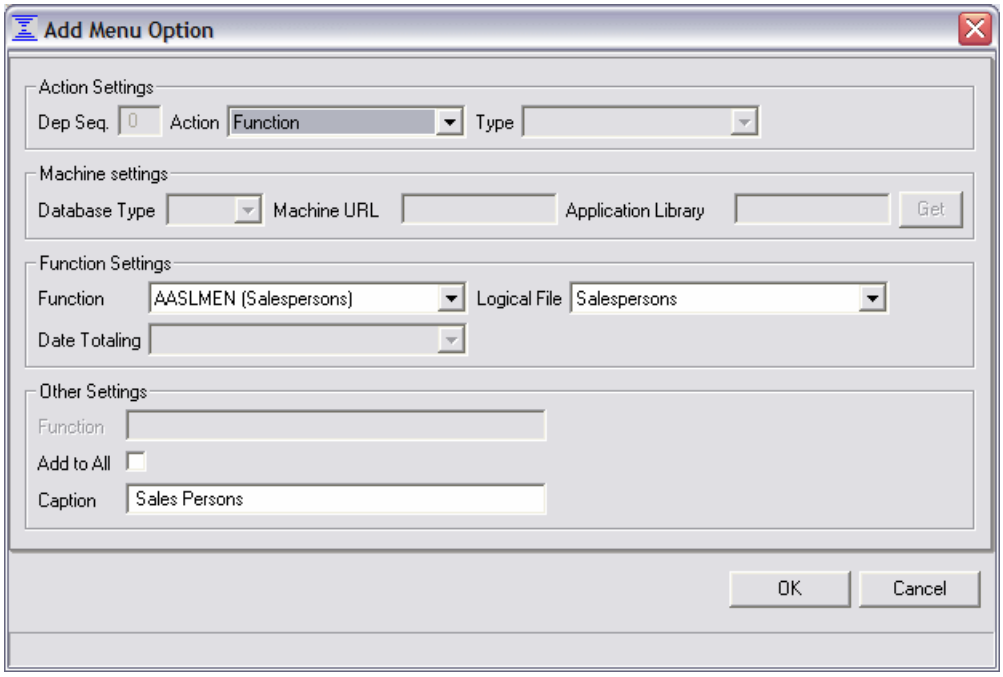

Figure 3-13 Function menu Add Menu Option dialog box

10. Add the Site link. Perform the following steps:
    a. Click **Add Menu Option**.
    b. In the Add Menu dialog box:
        i. Select **Function** from the Action pull-down list.
        ii. Select **AACUSTF (Sites)** from the Function pull-down list.
        iii. Select **Sites by Number** in the Logical File pull-down list.
        iv. Enter `Customer Sites` in the Caption Field.
    c. Click **OK**.
    d. In the Menu Properties dialog box, click **OK**.
11. Change the column headings to spell out Customer Number, Product Code, Status, Last Contact Date, and Next Contact Date:
    a. Click the **Field Layout** tab of the function definition editor.
    b. Locate the **Column Heading** column in the Field Layout tab and perform these steps:
        i. Click **Cus. No** (Figure 3-14) and enter `Customer Number`.
        ii. Click **Prod Code** and enter `Product Code`.
        iii. Click **Sts** and enter `Status`.
        iv. Click **Last Cnt Date** and enter `Last Contact Date`.
        v. Click **Next Cnt Date** and enter `Next Contact Date`.
        vi. Click **OK**.

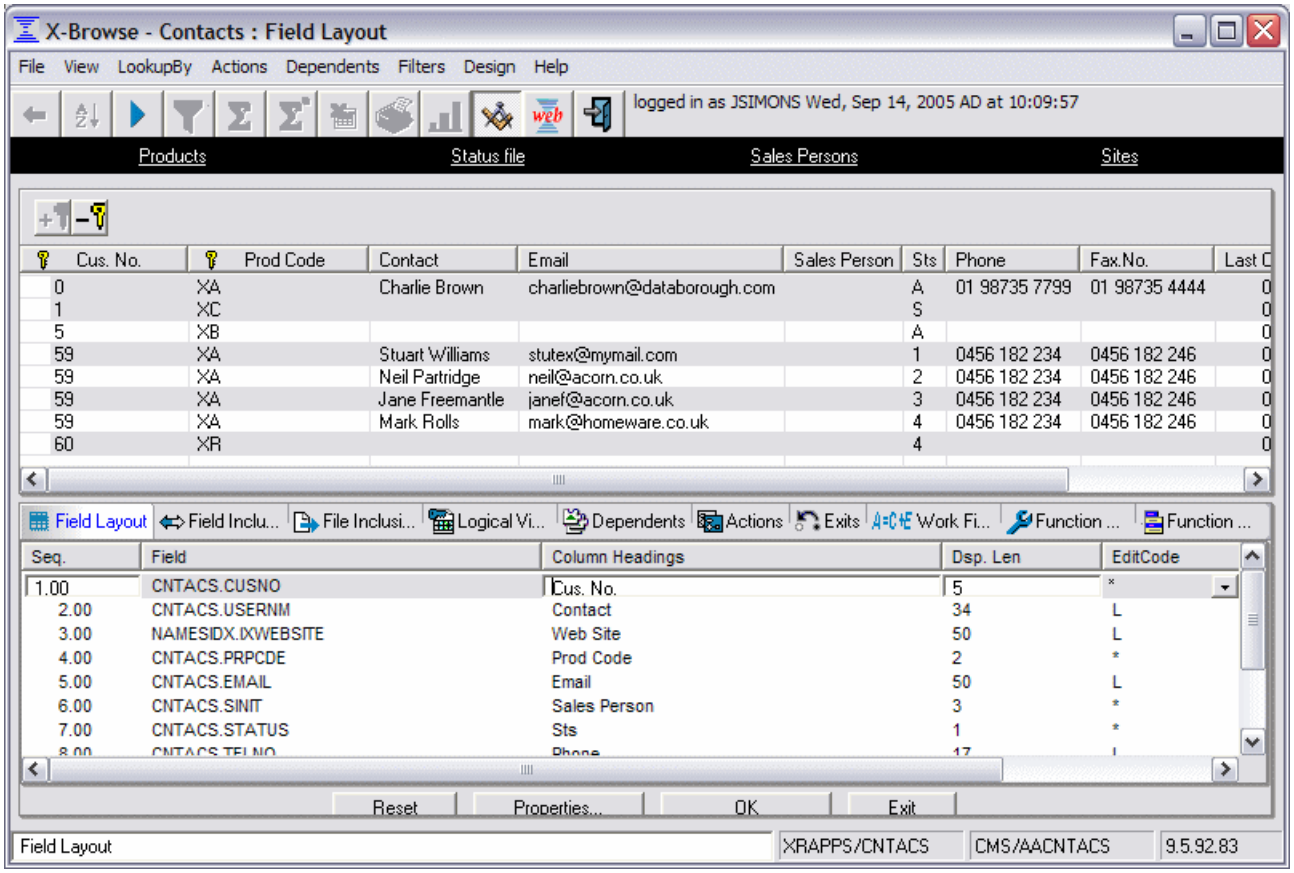
X-Browse - Contacts : Field Layout
File View LookupBy Actions Dependents Filters Design Help
logged in as JSIMONS Wed, Sep 14, 2005 AD at 10:09:57
Products Status file Sales Persons Sites
Cus. No. Prod Code Contact Email Sales Person Sts Phone Fax.No. Last C
0 XA Charlie Brown charliebrown@databorough.com A 01 98735 7799 01 98735 4444 0
1 XC S 0
5 XB A 0
59 XA Stuart Williams stutex@mymail.com 1 0456 182 234 0456 182 246 0
59 XA Neil Partridge neil@acorn.co.uk 2 0456 182 234 0456 182 246 0
59 XA Jane Freemantle janef@acorn.co.uk 3 0456 182 234 0456 182 246 0
59 XA Mark Rolls mark@homeware.co.uk 4 0456 182 234 0456 182 246 0
60 XR 4 0
Field Layout Field Inclu... File Inclusi... Logical Vi... Dependents Actions Exits Work Fi... Function ... Function ...
Seq. Field Column Headings Dsp. Len EditCode
1.00 CNTACS.CUSNO Cus. No. 5 *
2.00 CNTACS.USERNM Contact 34 L
3.00 NAMESIDX.IXWEBSITE Web Site 50 L
4.00 CNTACS.PRPCDE Prod Code 2 *
5.00 CNTACS.EMAIL Email 50 L
6.00 CNTACS.SINIT Sales Person 3 *
7.00 CNTACS.STATUS Sts 1 *
Reset Properties... OK Exit
Field Layout
XRAPPS/CNTACS
CMS/AACNTACS
9.5.92.83

Figure 3-14 Changing column heading in format AACNTACS

12. Change the order of the fields displayed in the grid to put Last Contact Date immediately after Contact, by doing these steps:

    a. Click the **Field Layout** tab of the function definition editor.

    b. Locate the **Seq.** column in the Field Layout tab. Click **Last Contact Date** and enter `2.5` into the Seq. field.

    c. Click **OK**.

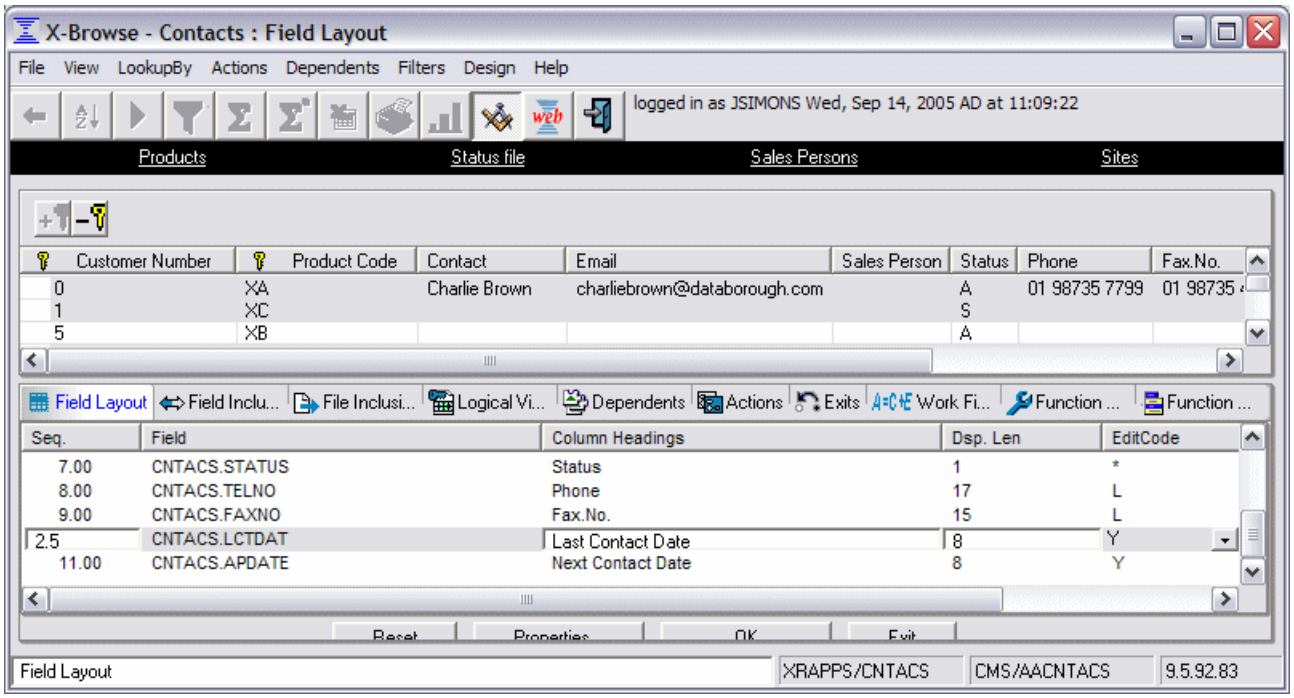
X-Browse - Contacts : Field Layout
File View LookupBy Actions Dependents Filters Design Help
logged in as JSIMONS Wed, Sep 14, 2005 AD at 11:09:22
Products Status file Sales Persons Sites
Customer Number Product Code Contact Email Sales Person Status Phone Fax.No.
0 XA Charlie Brown charliebrown@databorough.com A 01 98735 7799 01 98735
1 XC S
5 XB A
Field Layout Field Inclu... File Inclusi... Logical Vi... Dependents Actions Exits Work Fi... Function ... Function ...
Seq. Field Column Headings Dsp. Len EditCode
7.00 CNTACS.STATUS Status 1 *
8.00 CNTACS.TELNO Phone 17 L
9.00 CNTACS.FAXNO Fax.No. 15 L
2.5 CNTACS.LCTDAT Last Contact Date 8 Y
11.00 CNTACS.APDATE Next Contact Date 8 Y
Reset Properties OK Exit
Field Layout
XRAPPS/CNTACS
CMS/AACNTACS
9.5.92.83

Figure 3-15 Changing field order in format AACNTACS

13. Click **Exit** to close the function definition editor, and review the final function definition (Figure 3-16).

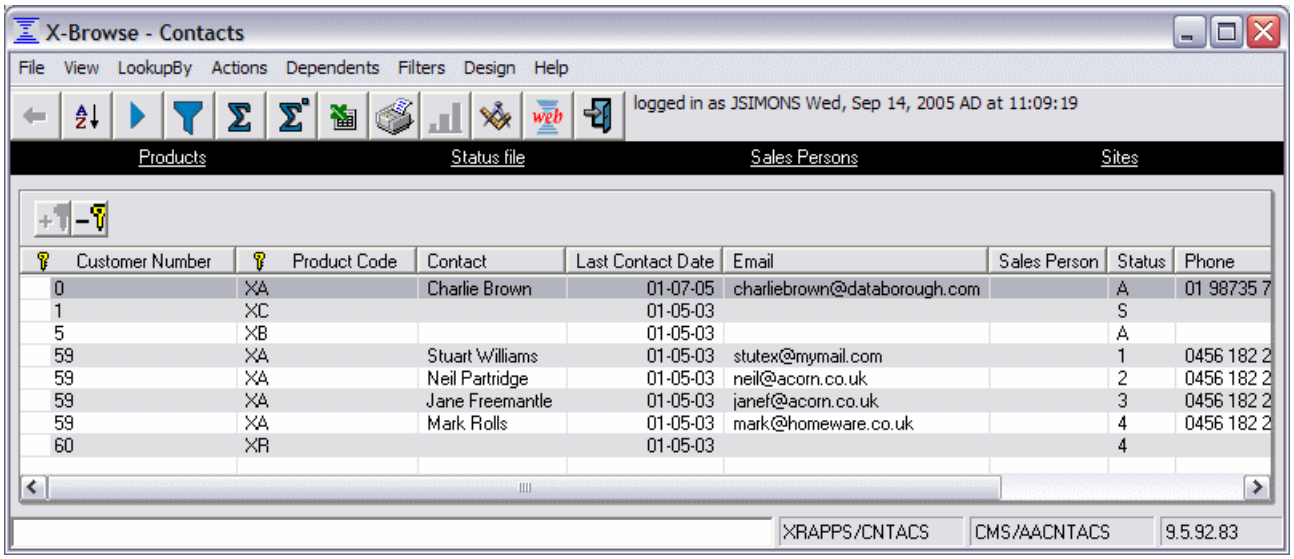
X-Browse - Contacts
File View LookupBy Actions Dependents Filters Design Help
logged in as JSIMONS Wed, Sep 14, 2005 AD at 11:09:19
Products Status file Sales Persons Sites
Customer Number Product Code Contact Last Contact Date Email Sales Person Status Phone
0 XA Charlie Brown 01-07-05 charliebrown@databorough.com A 01 98735 7
1 XC 01-05-03 S
5 XB 01-05-03 A
59 XA Stuart Williams 01-05-03 stutex@mymail.com 1 0456 182 2
59 XA Neil Partridge 01-05-03 neil@acorn.co.uk 2 0456 182 2
59 XA Jane Freemantle 01-05-03 janef@acorn.co.uk 3 0456 182 2
59 XA Mark Rolls 01-05-03 mark@homeware.co.uk 4 0456 182 2
60 XR 01-05-03 4
XRAPPS/CNTACS
CMS/AACNTACS
9.5.92.83

Figure 3-16 Final layout for format AACNTACS

You can click the various links to demonstrate how control flows between layouts. Click the Back button on the toolbar to return to the previous window. When you are done reviewing the layout, close the X-Browse - Contracts window to return to the X-Analysis client.

3.7.2 Customizing the Flat Screen SDF

To customize the Flat Screen SDF ZACNTACS, follow these steps:

1. Locate and right-click **ZACNTACS** under Screen Function Name in the Function List View of the X-Analysis client.
2. Select **Function Layout**. The window display for the ZACNTACS SDF appears (Figure 3-9 on page 48).
3. Click the Function Designer button on the toolbar.
4. The function definition editor opens in the lower pane of your window (Figure 3-17). Click the **Function Menu** tab to modify the links.

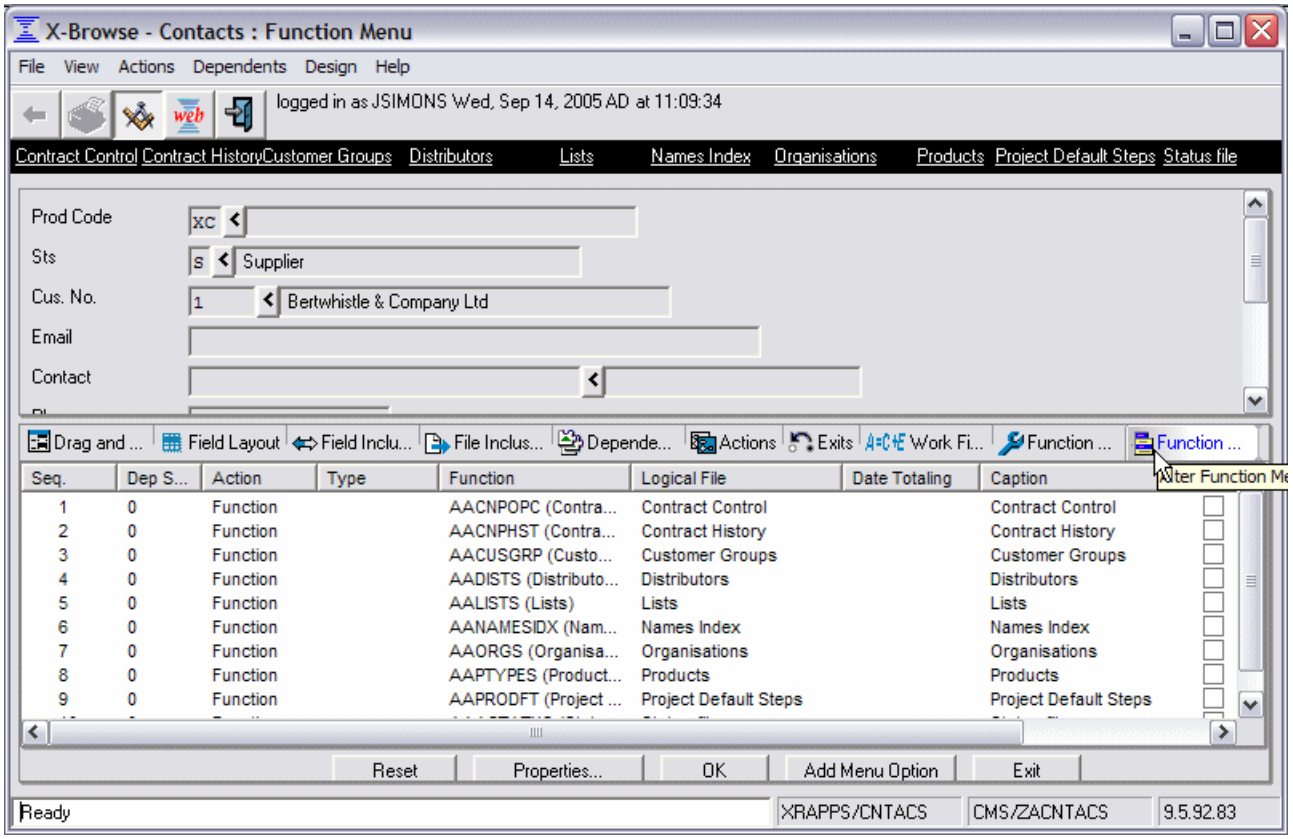
X-Browse - Contacts : Function Menu
File View Actions Dependents Design Help
logged in as JSIMONS Wed, Sep 14, 2005 AD at 11:09:34
Contract Control Contract History Customer Groups Distributors Lists Names Index Organisations Products Project Default Steps Status file
Prod Code XC
Sts S Supplier
Cus. No. 1 Bertwhistle & Company Ltd
Email
Contact
Drag and ... Field Layout Field Inclu... File Inclus... Depende... Actions Exits Work Fi... Function ... Function ...
Seq. Dep S... Action Type Function Logical File Date Totaling Caption
1 0 Function AACNPOPC (Contra... Contract Control Contract Control
2 0 Function AACNPHST (Contra... Contract History Contract History
3 0 Function AACUSGRP (Custo... Customer Groups Customer Groups
4 0 Function AADISTS (Distributo... Distributors Distributors
5 0 Function AALISTS (Lists) Lists Lists
6 0 Function AANAMESIDX (Nam... Names Index Names Index
7 0 Function AAORGS (Organisa... Organisations Organisations
8 0 Function AAPTYPES (Product... Products Products
9 0 Function AAPRODFT (Project ... Project Default Steps Project Default Steps
Reset Properties... OK Add Menu Option Exit
Ready XRAPPS/CNTACS CMS/ZACNTACS 9.5.92.83

Figure 3-17 Format ZACNTACS in the function definition editor

5. Remove the undesired links as follows:
   a. Locate the **Caption** column in the Function Menu tab.
   b. Select the check box in the **Delete** column (Figure 3-18) beside each of the following items:
      - Contract Control
      - Contract History
      - Customer Group
      - Distributors
      - List
      - Name Index
      - Organizations
      - Project Default Steps
   c. Click **OK**.

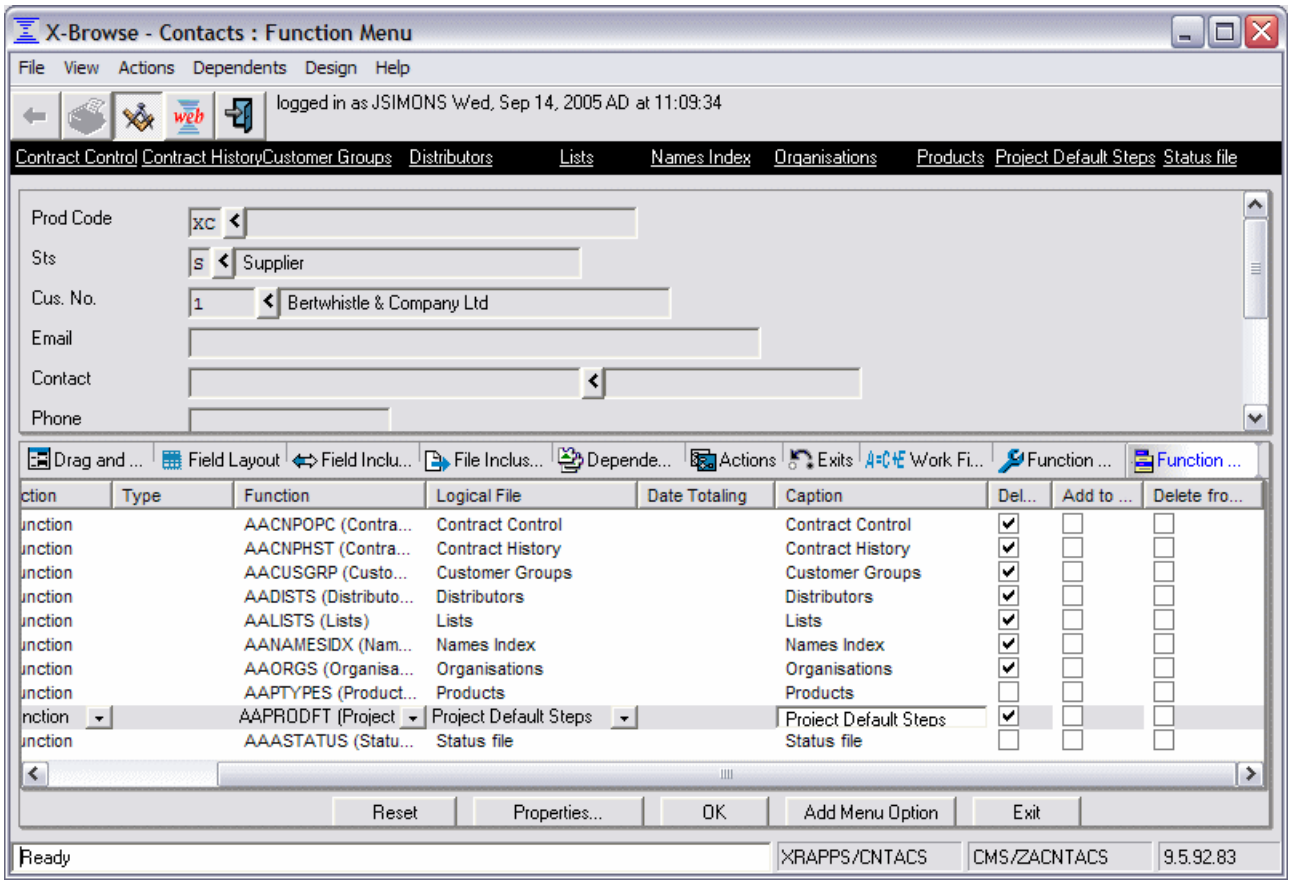
X-Browse - Contacts : Function Menu
File View Actions Dependents Design Help
logged in as JSIMONS Wed, Sep 14, 2005 AD at 11:09:34
Contract Control Contract History Customer Groups Distributors Lists Names Index Organisations Products Project Default Steps Status file
Prod Code XC
Sts S Supplier
Cus. No. 1 Bertwhistle & Company Ltd
Email
Contact
Phone
Drag and ... Field Layout Field Inclu... File Inclus... Depende... Actions Exits Work Fi... Function ... Function ...
ction Type Function Logical File Date Totaling Caption Del... Add to ... Delete fro...
unction AACNPOPC (Contra... Contract Control Contract Control
unction AACNPHST (Contra... Contract History Contract History
unction AACUSGRP (Custo... Customer Groups Customer Groups
unction AADISTS (Distributo... Distributors Distributors
unction AALISTS (Lists) Lists Lists
unction AANAMESIDX (Nam... Names Index Names Index
unction AAORGS (Organisa... Organisations Organisations
unction AAPTYPES (Product... Products Products
nction AAPRODFT (Project Project Default Steps Project Default Steps
unction AAASTATUS (Statu... Status file Status file
Reset Properties... OK Add Menu Option Exit
Ready
XRAPPS/CNTACS
CMS/ZACNTACS
9.5.92.83

Figure 3-18 Deleting links in format ZACNTACS

6. Add the Salesperson link by performing the following steps:
   a. Click **Add Menu Option**.
   b. In the Add Menu Option dialog box (Figure 3-19):
      i. Select **Function** from the Action pull-down list.
      ii. Select **AASLMEN (SalesPersons)** from the Function pull-down list.
      iii. Select **Salespersons** in the Logical File pull-down list.
      iv. Enter `Sales Persons` in the Caption field.
   c. Click **OK**.
   d. In the Menu Properties dialog box, click **OK**.

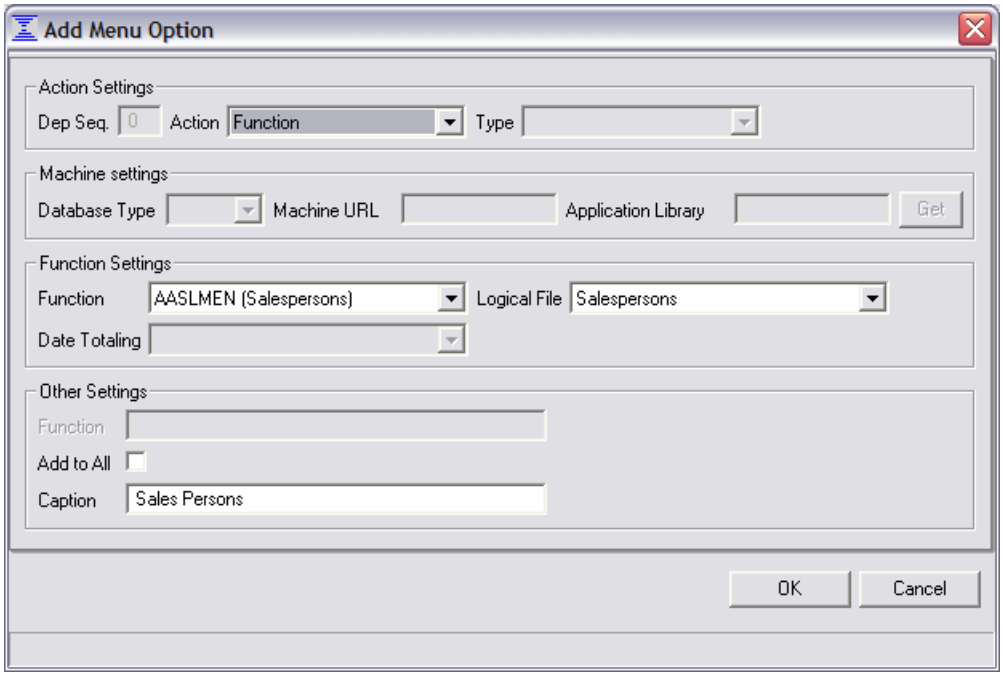

Figure 3-19 Function menu Add Menu Option dialog box

7. Add the Site link:
   a. Click **Add Menu Option**.
   b. In the Add Menu Option dialog box:
      i. Select **Function** from the Action pull-down list.
      ii. Select **AACUSTF (Sites)** from the Function pull-down list.
      iii. Select **Sites by Number** in the Logical File pull-down list.
      iv. Enter `Customer Sites` in the Caption Field.
   c. Click **OK**.
   d. In the Menu Properties dialog box, click **OK**.
8. Change the field text to spell out Customer Number, Product Code, Status, Last Contact Date, and Next Contact Date:
   a. Click the **Field Layout** tab of the function definition editor.

b. Locate the **Constant/Field Name** column in the Field Layout tab.

i. Click **Prod Code** (Figure 3-20) and enter `Product Code`.

ii. Click **Sts** and enter `Status`.

iii. Click **Cus. No** and enter `Customer Number`.

iv. Click **Last Cnt Date** and enter `Last Contact Date`.

v. Click **Next Cnt Date** and enter `Next Contact Date`.

vi. Click **OK**.

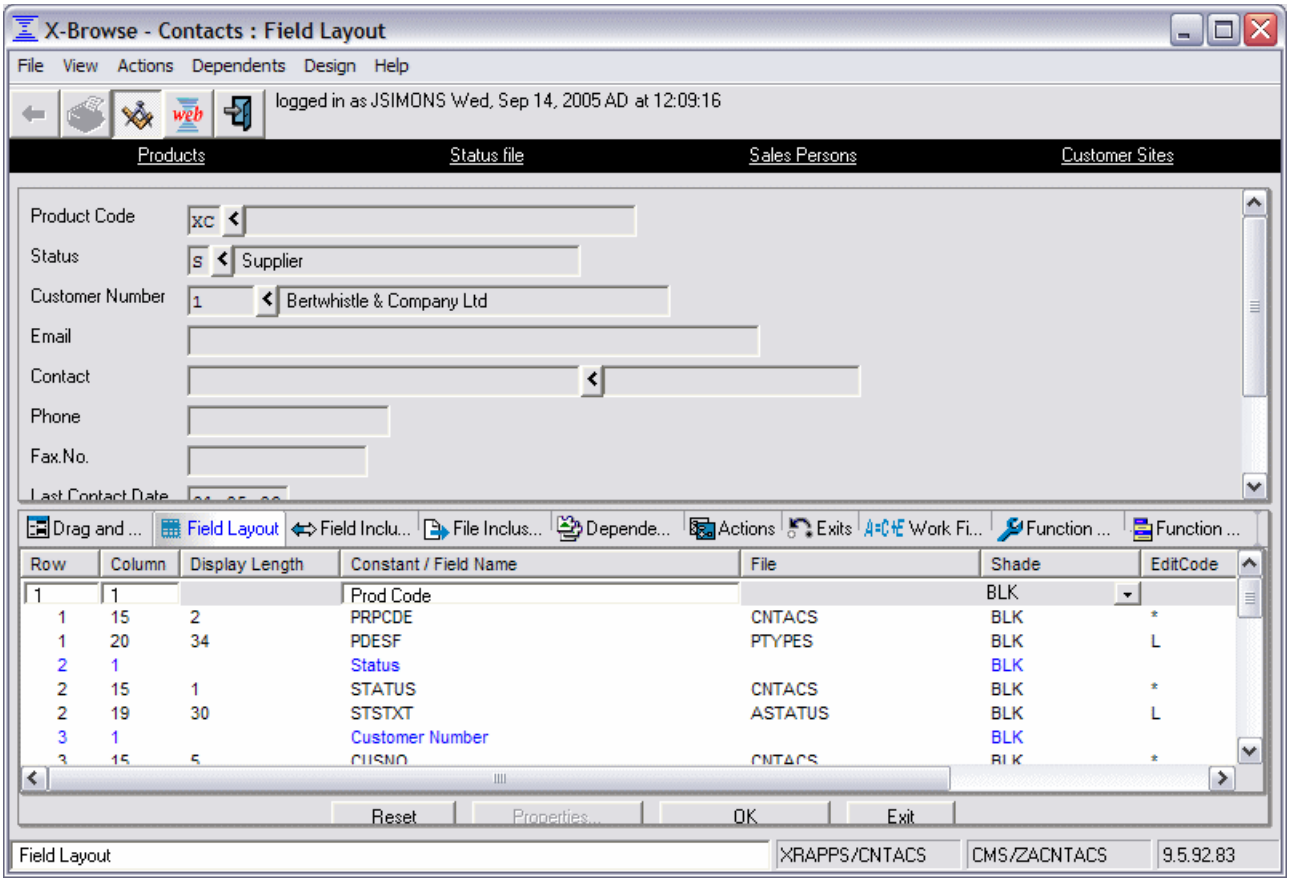

Figure 3-20 Changing field text in format ZACNTACS

9. Change the order in which the fields are displayed to more closely match the existing display layout (Figure 3-10 on page 49):

a. Click the **Field Layout** tab of the function definition editor.

b. Locate the **Row** column in the Field Layout tab.

i. Click **Product Code** and enter `2` in the row field.

ii. Click **PRPCD** and enter `2` in the Row field.

iii. Click **PDESF** and enter `2` in the Row field.

iv. Click **Status** and enter `11` in the Row field.

v. Click **STATUS** and enter `11` in the Row field.

vi. Click **STSTXT** and enter `11` in the Row field.

vii. Click **Customer Number** and enter `1` in the Row field.

viii. Click **CUSTNO** and enter 1 in the Row field.

ix. Click **CNAME** and enter 1 in the Row field.

x. Click **Contact** and enter 3 in the Row field.

xi. Click **USERNM** and enter 3 in the Row field.

xii. Click **IXWEBSITE** and enter 3 in the Row field.

xiii. Click **Phone** and enter 5 in the Row field.

xiv. Click **TELNO** and enter 5 in the Row field.

xv. Click **Fax. No** and enter 2 in the Row field.

xvi. Click **FAXNO** and enter 2 in the Row field.

c. Click **OK**.

10. Click **Exit** to close the function definition editor, and review the final function definition (Figure 3-21).

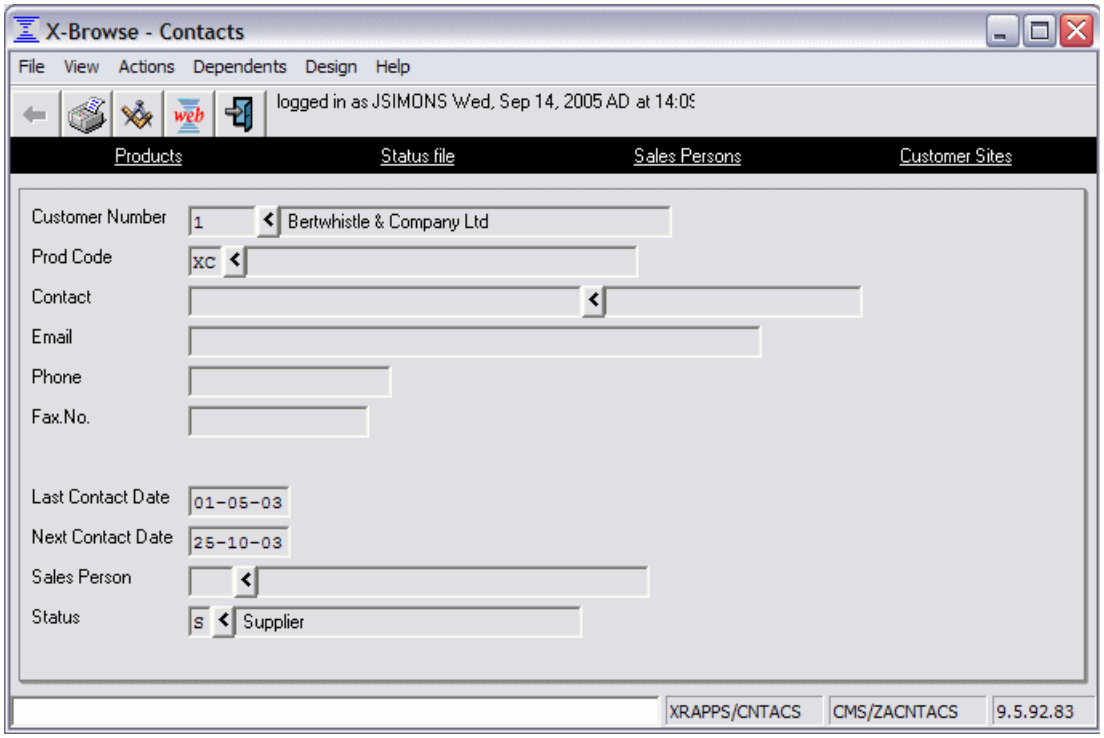

Figure 3-21 Final layout for format ZACNTACS

Tip: As an alternative to changing the screen layout using the row and column fields in the Field Layout tab, you can use the Drag and Drop tab of the function definition editor to move the fields graphically.

You can click the various links to demonstrate how control flows between layouts. Click the Back button on the toolbar to return to the previous window. When you are done reviewing the layout, close the X-Browse - Contacts window to return to the X-Analysis client.

3.8 Running the X-Analysis MVC re-engineering process

The X-Analysis MVC re-engineering process consists of three logical components (Figure 3-22).

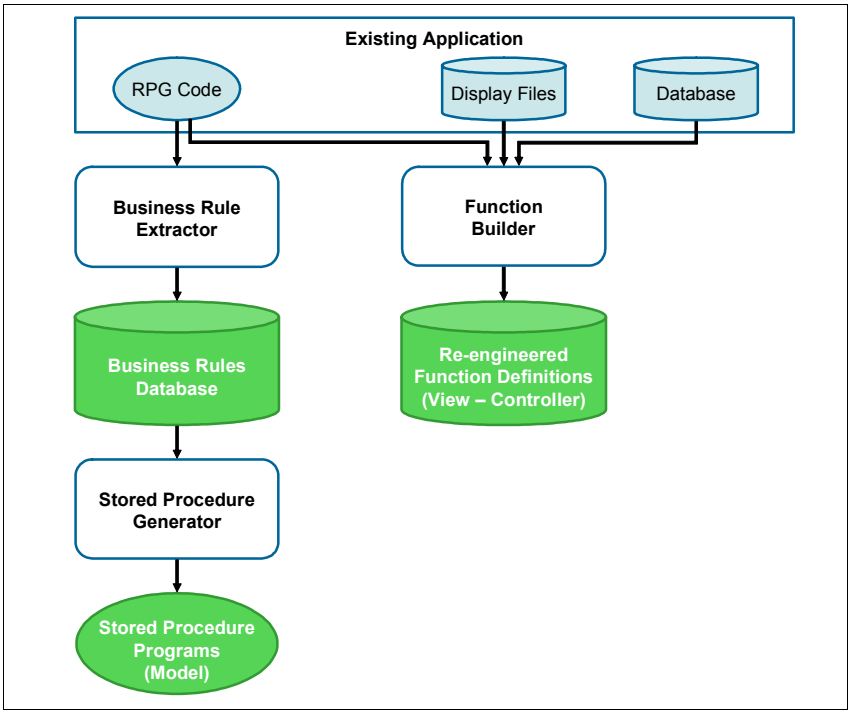

Figure 3-22 X-Analysis re-engineering components

- The *Business Rule Extractor* reviews the existing application RPG code for the display programs and separates the business logic code from the screen control and presentation code. It then parses the business logic code into a set of business rules that are stored in the business rules database.
- The *Stored Procedure Generator* uses the business rules database to generate the RPG stored procedure programs. The generated stored procedure programs form the Model component of the MVC architecture.
- The *Function Builder* uses the RPG code and display files from the existing application's display programs to build the re-engineered function definitions (RFDs). The RFDs are used for the View-Controller components of the MVC architecture.

These three logical components are tightly coupled and cannot be run separately. When the X-Analysis MVC re-engineering process is run, all three components are executed automatically.

3.8.1 Running the MVC re-engineering process over an application area

For the CMS system, the re-engineered function definitions for the CUSTSYS application area are generated as a group:

1. In the left pane of the X-Analysis client window, locate the CUSTSYS application area under the CMS cross-reference repository.

2. Right-click the CUSTSYS application area and select **Re-engineer Bus. Rule Pgms & Screens** (Figure 3-23).

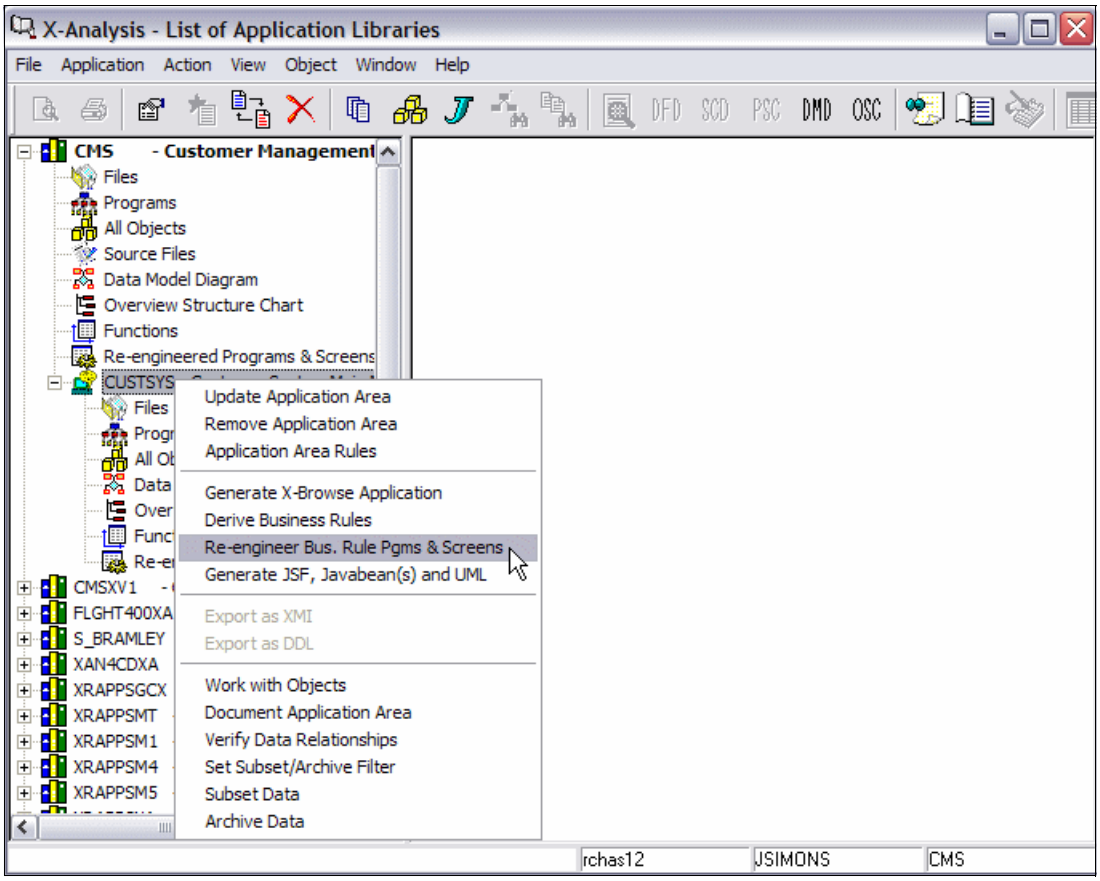

Figure 3-23 Re-engineer Business Rule Programs & Screens

3. On the Re-engineer Bus Rule Programs & Screens dialog box (Figure 3-24), select **Re-engineer Screens** and click **OK** to continue.

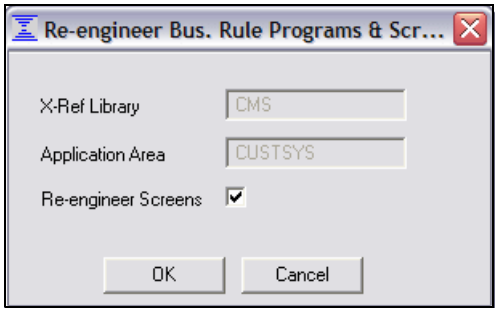

Figure 3-24 Re-engineer Bus. Rule Programs & Screens dialog box

4. The Re-engineer Bus Rule Programs & Screens Status Box (Figure 3-25) appears as the business rules, stored procedures, and RFD are generated interactively from the existing application programs. When the `Job Completed` message appears, click **Close**.

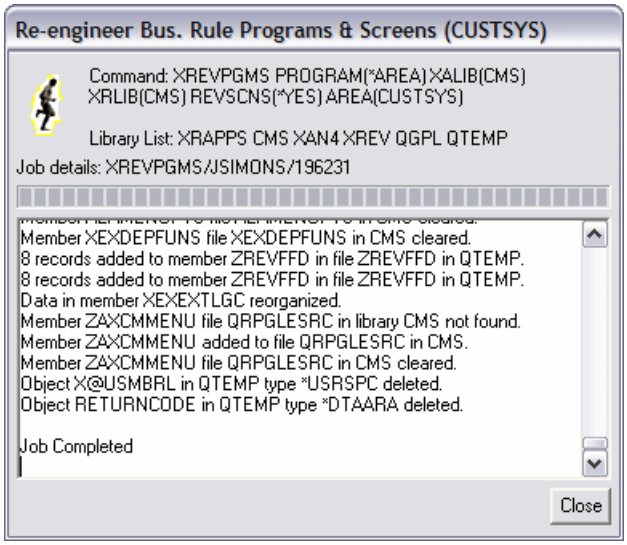
Re-engineer Bus. Rule Programs & Screens (CUSTSYS)
Command: XREVPGMS PROGRAM(*AREA) XALIB(CMS) XRLIB(CMS) REVSCNS(*YES) AREA(CUSTSYS)
Library List: XRAPPS CMS XAN4 XREV QGPL QTEMP
Job details: XREVPGMS/JSIMONS/196231
Member XEXDEPFUNS file XEXDEPFUNS in CMS cleared.
8 records added to member ZREVFFD in file ZREVFFD in QTEMP.
8 records added to member ZREVFFD in file ZREVFFD in QTEMP.
Data in member XEXEXTLGC reorganized.
Member ZAXCMMENU file QRPGLESRC in library CMS not found.
Member ZAXCMMENU added to file QRPGLESRC in CMS.
Member ZAXCMMENU file QRPGLESRC in CMS cleared.
Object X@USMBRL in QTEMP type *USRSPC deleted.
Object RETURNCODE in QTEMP type *DTAARA deleted.
Job Completed
Close

Figure 3-25 Re-engineer Bus. Rule Programs & Screens status box

5. *Immediately repeat steps 2 on page 61, 3 on page 61, and 4.* When running the MVC re-engineering process in a group, there are some situations where a processing order issue can cause errors in the generated RFDs. For this reason it is important to run the process *at least twice*, which will ensure that the correct RFDs are built.

Notes:

- The X-Analysis Function Builder reviews the existing display application in a group build in serial order. It checks each existing program to determine what other display programs are accessed, and then checks those programs to see whether they have RFDs. If an RFD for a called program is not available, the Function Builder will not correctly build the links between the descriptions. For example, if Program A calls Program B, and both will have RFDs, when Program A's RFDs are generated, the Function Builder will not find Program B's RFDs, as it has not processed Program B yet. This will result in the RFDs for Program A not linking correctly to the RFDs for program B. Performing a second run corrects this problem, because when Program A's RFDs are rebuilt, the RFDs for Program B will exist.
- The Re-engineer Bus. Rule Pgms & Screens function in X-Analysis may be run repeatedly. When an RFD is regenerated, it simply replaces the prior version.

3.8.2 Running the MVC re-engineering process over an individual program

The MVC re-engineering process may also be run over an individual existing application display program:

1. In the left pane of the X-Analysis client window, locate and expand the **CUSTSYS** application area under the CMS cross-reference repository.
2. In the expanded CUSTSYS application area, double-click **Programs**.
3. In the Work with Objects dialog box, click **OK**.

4. The object list for the CUSTSYST application area appears in the right column of the X-Analysis client.

   a. Locate the interactive program **CUSFMAINT**.

   b. Right-click **CUSFMAINT** and select **Re-engineer Bus. Rule Pgms & Screens** (Figure 3-26).

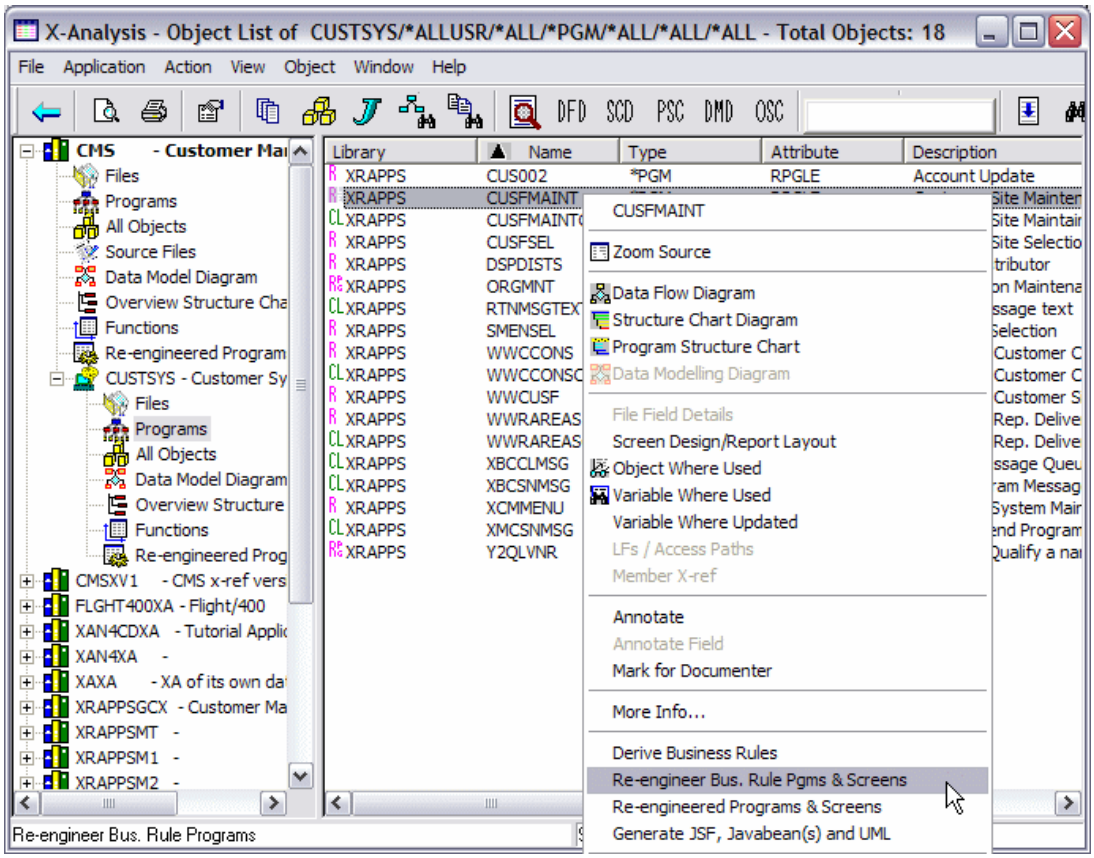

Figure 3-26 Individual Re-engineer Bus. Rule Pgms & Screens

   c. On the Re-engineer Bus Rule Programs & Screens dialog box (Figure 3-27), select **Update Screens** and click **OK** to continue.

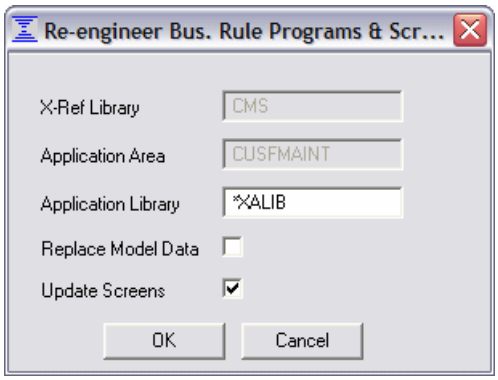

Figure 3-27 Individual Re-engineer Bus Rule Pgms & Screens dialog box

d. The Re-engineer Bus Rule Pgms & Screens status box (Figure 3-25 on page 62) appears as the re-engineered functions are generated from the existing application program interactively. When the `Job Completed` message appears, click **Close**.

Tip: Be careful not to confuse the Re-engineer Bus. Rule Pgms & Screens option, which generates the RFDs and stored procedures, with the Re-engineered Programs & Screens option that immediately follows it, which enables you to view the RFDs and stored procedures that you have already generated.

3.9 Reviewing the re-engineered function definitions

When we run the MVC re-engineering process, it invokes the Function Builder to create a set of re-engineered function definitions based on the application business and display logic.

Important: In some cases, the Function Builder recognizes that building an RFD would be redundant, because a SFD already exists that provides the required functionality. In these cases, an RFD is not built, and instead X-Analysis assigns the re-engineered stored procedure to the existing SFD. The X-Analysis client recognizes when this occurs, and includes the reused SFD in its Re-engineered Programs View.

To view the RFDs in the X-Analysis client, perform the following steps:

1. In the left pane of the X-Analysis client window, locate and expand the **CUSTSYS** application area under the CMS cross-reference repository.
2. In the expanded CUSTSYS application area, double-click **Re-engineered Program & Screens**.
3. The Re-engineered Programs View for the CUSTSYS application area appears in the right pane of the X-Analysis client window (Figure 3-28). The RFDs appear in the Screen Function Name column.

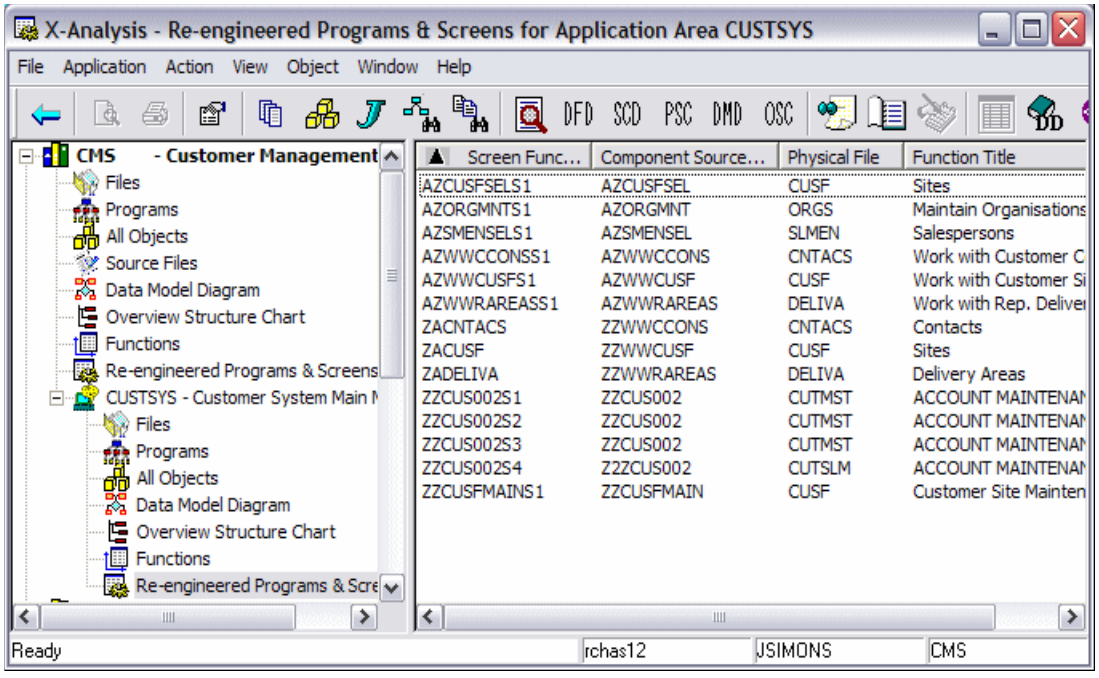

Figure 3-28 CUSTSYS Re-engineered Programs & Screens

Tip: This RFD list can also be reached by double-clicking **Functions** in the application area and selecting **Re-engineered Functions** in the Work with Object dialog box.

Note: When generated, RFDs are also included in the general Function List View.

3.9.1 Re-engineered function definition naming conventions

Every X-Analysis function definition has a unique function name. X-Analysis automatically names each function when it is generated. X-Analysis adopts a specific naming convention for re-engineered function definitions that distinguishes the function type, the source display program, and the logical screen. A *logical screen* is a group of one or more screen formats that are overlaid to display one screen to the user.

The RFD name consists of three parts:

- A two-letter identifier based on the function type:
  - AZ for Grid Functions (Type A)
  - ZZ for Flat Screen Functions (Type Z)
- The existing application display program name. If the program name is longer than eight characters, only the first eight characters are used.
- A suffix identifying the logical screen represented by the RFD:
  - S1 for the first logical screen
  - S2 for the second logical screen
  - S3 for the third logical screen

  and so forth.

As an example, the Grid RFD for the first screen in the ORGMNT application program is AZORGMNTS1. The Flat Screen RFD for the third screen in the CUS002 application program is ZZCUS002S3.

Tip: In the X-Analysis client, the RFDs are listed in the first column of the Re-engineered Programs View under the heading *Screen Function Name*. Their associated stored procedures are listed in the second column under the heading *Component Source Member*.

3.9.2 Viewing the function layout

Each RFD contains layout information about how a window should be displayed to the user. The X-Analysis client includes the function definition editor that lets you review and modify the automatically generated layouts.

For this example, two of the RFDs for the CMS Customers Main Menu Option 1 - Customer Site Maintenance (Figure 2-2 on page 18) are reviewed:

- AZCUSFSELS1 - The Grid RFD for the CUSFSEL customer selection program
- ZZCUSFMAINS1 - The Flat Screen RFD for the CUSFMAINT customer maintenance program

The CUSFSEL program lets the user select a customer record from a list for maintenance purposes (Figure 3-29 on page 66). The AZCUSFSELS1 function definition must provide at least the same functionality.

```
Please select:
  00001 Bertwhistle & Compan
  00004 Teflon Company of G.
  00005 Turbine Components L
  00006 Gough Research plc
  00009 Newt Foods UK Ltd.
  00014 Bock & Co. Ltd
  00015 Besson Bros.
  00017 Media Enterprises Lt
  00018 Bays Engineering Ltd
  00021 Goldfish & Sons Ltd +
```

Figure 3-29 CUSFSEL customer site selection display

The CUSFMAINT program displays a single record from the CUSF file and allows the user to change the record. It provides basic verification for several fields and function keys that link to the contacts, distributors, and delivery views. The function definition ZCUSFMAINS1 must provide that same display, edit, verification, and linking functionality.

```
Customers          Customer Site Maintenance                Databorough Ltd.
CUSFMAINT                                                          15:18:22
                                                                15 Sep 2005
Customer No . . . . . . . 00006
Customer Name . . . . . . Gough Research plc
Address . . . . . . . . . Gough House
                          Tanger Lane
                          Westgate
                          Suffolk
Country . . . . . . . . . England
Postcode  . . . . . . . . T5 1UA
Telephone No  . . . . . . 0191 967 0007
Fax. No . . . . . . . . . 0191 967 411
Email Address . . . . . . judyg@gough.org
Website . . . . . . . . . www.goughresearch.org
Distributor, Salesperson      STU
Status  . . . . . . . . . 8
Contact . . . . . . . . . Judy Garland
Title . . . . . . . . . . Ms
Job Title . . . . . . . . Systems Director
Last Contact Date . . . . 2003-04-08
Next Contact Date . . . . 2003-10-06
Please make required changes. (F8=Contacts,F9=Distributor,F10=Del.Areas)
```

Figure 3-30 CUSFMAINT Customer Site Maintenance display

Attention: The CMS Customers Main Menu actually has two options for displaying and maintaining the CUSF file. Both Option 1 and Option 5 perform these functions using different display programs. Because of this, two sets of function definitions were developed by the X-Analysis MVC re-engineering process. AZCUSFSELS1 and ZACUSFMAINTS1 correspond to Option 1, while AZWWCUSFS1 and the reused SFD ZACUSF correspond to Option 5.

The Grid RFD for the CUSFSEL customer selection program

To display the layout for this function definition:

1. Locate and right-click **AZCUSFSELS1** under Screen Function Name in the Re-engineered Programs View of the X-Analysis client.
2. Select **Function Layout**.

The window display for the AZCUSFSELS1 function definition (Figure 3-31) appears. Similar to CUSFSEL, the AZCUSFSELS1 function layout shows a list of records from the CUSTF file.

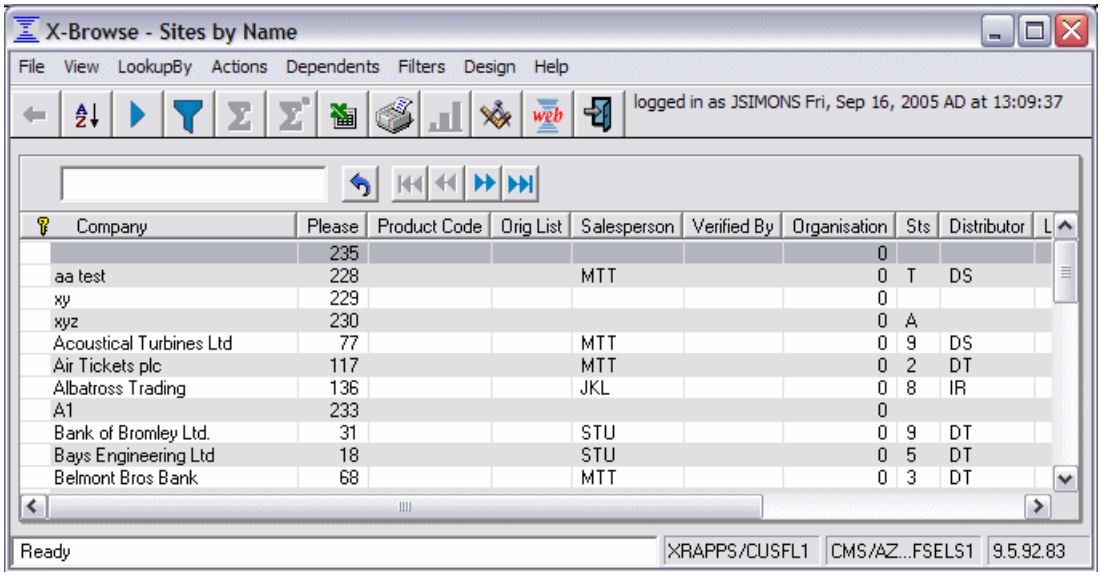
X-Browse - Sites by Name
File View LookupBy Actions Dependents Filters Design Help
logged in as JSIMONS Fri, Sep 16, 2005 AD at 13:09:37
Company Please Product Code Orig List Salesperson Verified By Organisation Sts Distributor
235 0
aa test 228 MTT 0 T DS
xy 229 0
xyz 230 0 A
Acoustical Turbines Ltd 77 MTT 0 9 DS
Air Tickets plc 117 MTT 0 2 DT
Albatross Trading 136 JKL 0 8 IR
A1 233 0
Bank of Bromley Ltd. 31 STU 0 9 DT
Bays Engineering Ltd 18 STU 0 5 DT
Belmont Bros Bank 68 MTT 0 3 DT
Ready
XRAPPS/CUSFL1
CMS/AZ...FSELS1
9.5.92.83

Figure 3-31 AZCUSFSELS1 function layout

The AZCUSFSELS1 function layout provides all of the functionality of the CUSFSEL Customer Site selection module. It displays a list of records from the CUSTF file, from which the user can page up and down, or click a row to select an individual record. In addition, the RFD AZCUSFSELS1 contains additional functionality that is not available in CUSFSEL, such as position to, filtering, and alternate views. The RFD functions are available using the following window controls:

Page up

Page down

Position to

Alternate View

Display

Filter

The Flat Screen RFD for the CUSFMAINT site maintenance program

To display the layout for the ZZCUSFMAINS1 function definition:

1. Locate and right-click **ZZCUSFMAINS1** under Screen Function Name in the Re-engineered Programs View of the X-Analysis client.
2. Select **Function Layout**.

The window display for the ZZCUSFMAINS1 function definition (Figure 3-32) appears. The ZZCUSFMAINS1 provides a single record display that generally follows the same layout as the CUSFMAINT display program.

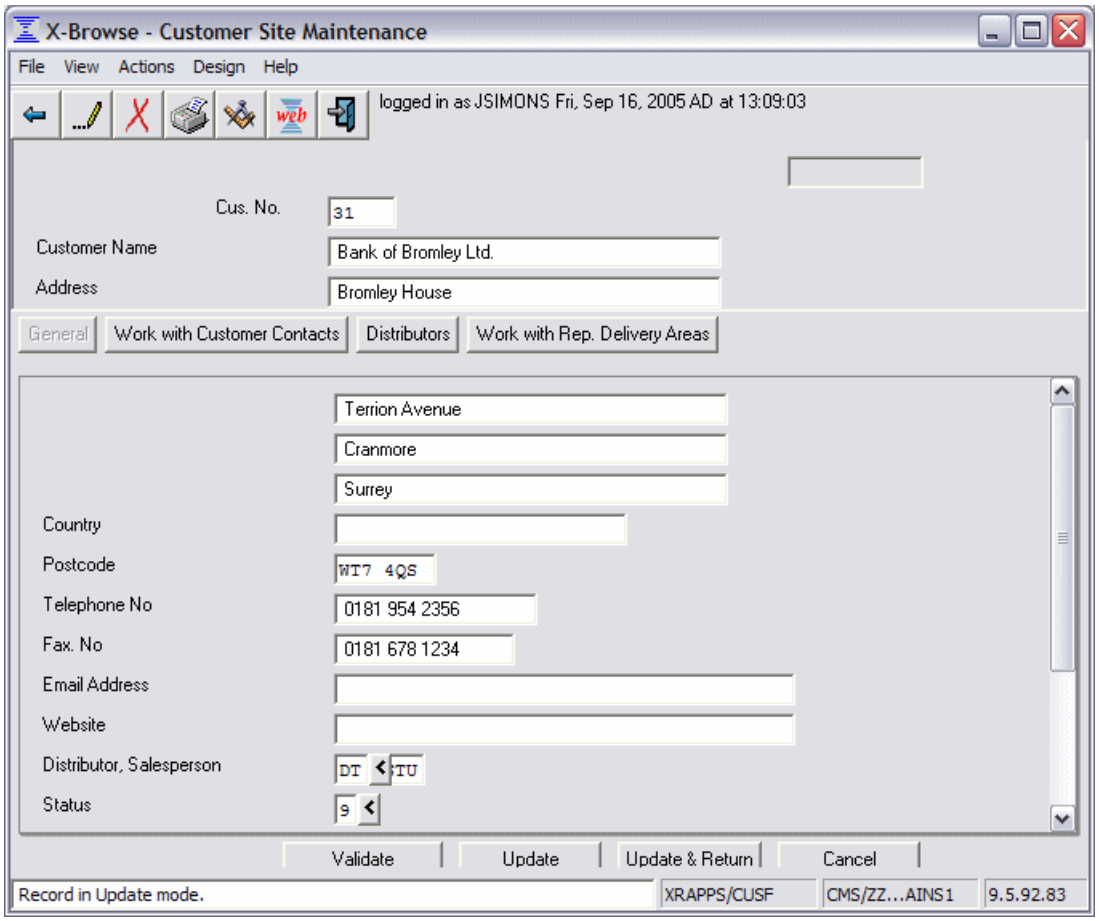

Figure 3-32 ZZCUSFMAINS1 function layout

Header fields

This MVC re-engineering process has assigned the first three fields on the screen to be header fields. These fields will stay at the top of the screen even as the other fields are scrolled.

Validation

The ZZCUSFMAINS1 RFD is linked to the ZZCUSTFMAIN stored procedure to provide the same business rule validation as the existing display program.

To demonstrate the validation, perform the following steps:

1. Enter `BADVALUE` in the Telephone No. field.
2. Click **Validate**.
3. The status bar shows this message: `The telephone no. is invalid.`

To review the code that performed this validation, refer to 3.10.3, “Reviewing the re-engineered stored procedure source code” on page 72.

Function keys

The function keys from the CUSFMAINT application (F8=Contacts, F9=Distributor, F10=Del.Areas) are implemented as a button bar in the middle of the ZZCUSFMAINS1 window. These buttons are called *dependent buttons*.

Figure 3-33 ZZCUSFMAINS1 dependent buttons

To demonstrate how the dependent buttons work, click **Distributors**. The distributor information appears in the lower pane of the ZZCUSFMAINS1 format (Figure 3-34). To return to the detail information, click **General**.

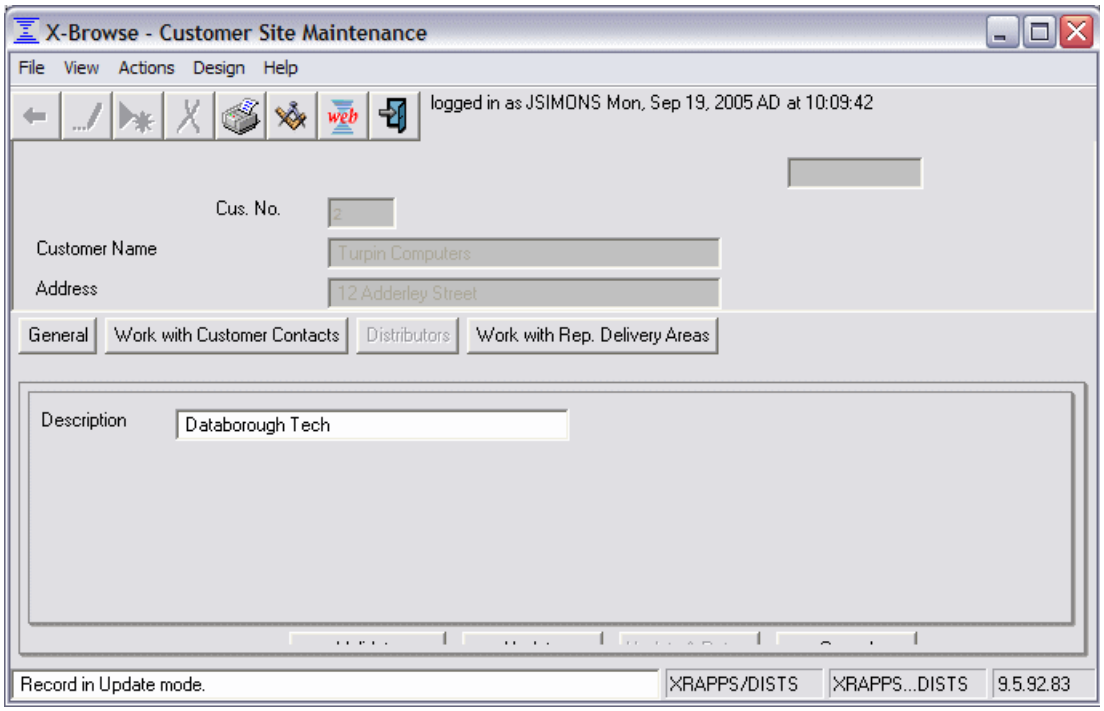

Figure 3-34 ZZCUSFMAINS1 Distributors dependent button

Foreign key references

Using the data model, X-Analysis determines whether certain fields act as foreign keys into other files. When this is the case, X-Analysis adds the ability to view and update the potential values for the foreign key. X-Analysis recognized two fields that were also foreign keys in the ZZCUSFMAINS1 format:

- The distributor code is a key into the distributor file DISTS.
- The status code is a key into the status file ASTATUS.

Reference buttons are automatically provided for these foreign keys (located beside the field names). Click on a foreign key reference button beside a field to open a selection window with available values for that field (Figure 3-35).

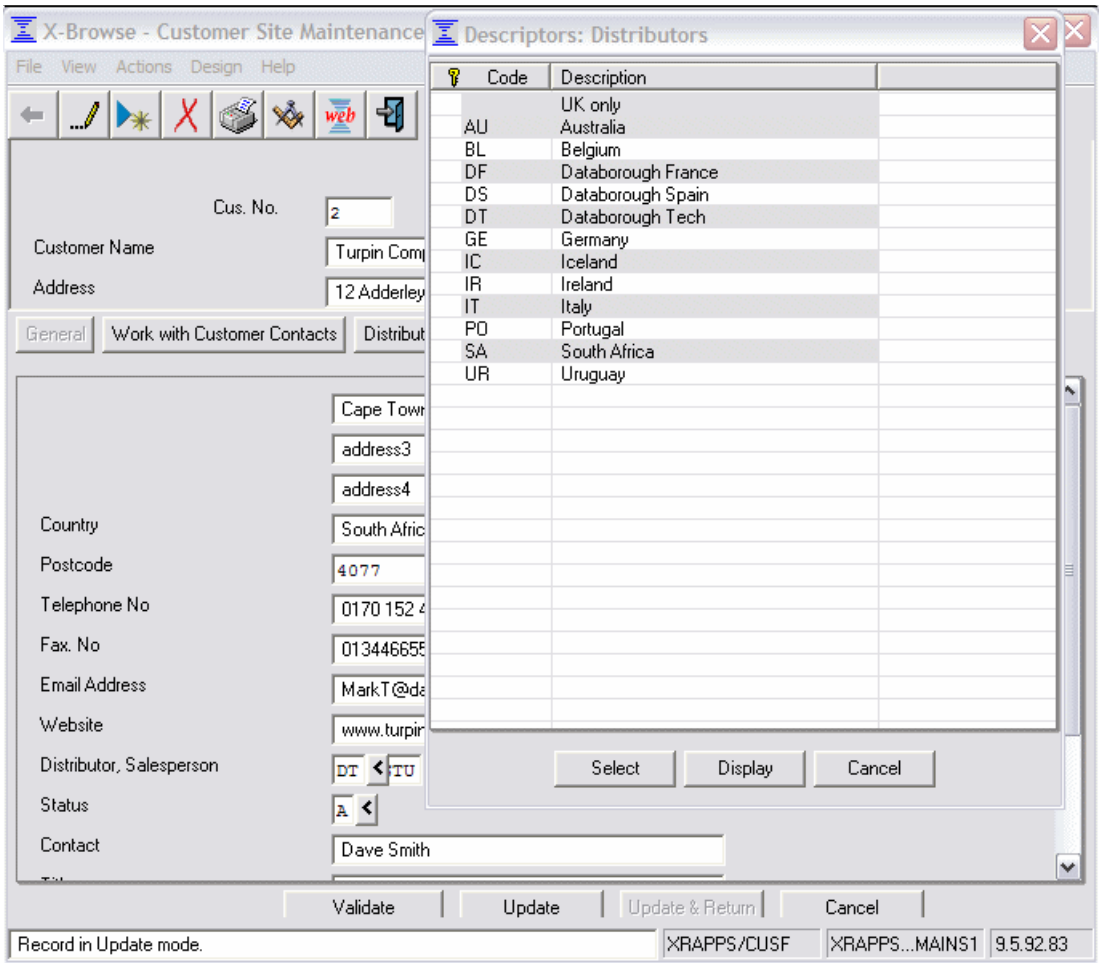

Figure 3-35 Foreign key references

3.10 Reviewing the re-engineered stored procedures

A re-*engineered stored procedure* (hereafter referred to as *stored procedure*) is an RPG module that holds the business rules extracted from the existing display program. It is re-engineered into a format where it can provide Model component functionality to the RFD.

Every X-Analysis re-engineered function definition has a corresponding stored procedure. Each RFD has only one stored procedure, but a stored procedure may be used by multiple RFDs.

To view the stored procedures in the X-Analysis client, perform the following steps:

1. In the left pane of the X-Analysis client window, locate and expand the **CUSTSYS** application area under the CMS cross-reference repository.
2. In the expanded CUSTSYS application area, double-click **Re-engineered Program & Screens**.

   The Re-engineered Programs View for the CUSTSYST application area appears in the right window of the of the X-Analysis client (Figure 3-28 on page 64). The stored procedures are shown in the Component Source Member column.

Tip: Stored procedures can also be reached by double-clicking **Functions** under the application area. Stored procedures are shown in the *Stored Procedure Name* column of the Function List View.

3.10.1 Re-engineered stored procedure naming conventions

Every X-Analysis stored procedure has a unique name. X-Analysis automatically names each stored procedure when it is generated. X-Analysis adopts a specific naming convention for the re-engineered stored procedure that distinguishes its associated function type and the display program that was the source of its business rules.

The stored procedure name consists of two parts:

- A two-letter identifier based on the function type:
  - AZ for Grid Functions (Type A)
  - ZZ for Flat Screen Functions (Type Z)
- The existing application display program name. If the program name is longer than eight characters, only the first eight characters are used.

As an example, the stored procedure for the Grid Functions for the ORGMNT application program is named AZORGMNT. The stored procedure for the Flat Screen Functions for the CUS002 application program is named ZZCUS002.

Important: Stored procedures are also referred to as *shadow programs* in the X-Analysis documentation.

3.10.2 Linking a re-engineered stored procedure to a function definition

Stored procedures hold the business rules that the MVC re-engineering process extracted from the display program source. When we run the MVC re-engineering process, it automatically links each re-engineered function definition to the appropriate stored procedure. A function definition can be set to call a stored procedure at the following points:

- Pre-entry
- Pre-display
- Pre-update
- Post-update
- Validation
- On exit

To determine where a stored procedure for the ZZCUSFMAINS1 RFD is set to be called, perform the following steps:

1. Locate and right-click **ZZCUSFMAINS1** under Screen Function Name in the Re-engineered Programs View of the X-Analysis client.
2. Select **Function Layout**. The window display for the ZZCUSFMAINS1 function definition (Figure 3-32 on page 68) appears.
3. Click the Function Designer button on the toolbar.
4. The function definition editor opens in the lower pane of your window. Click the **Function Maintenance** tab to view the stored procedure calls (Figure 3-36).

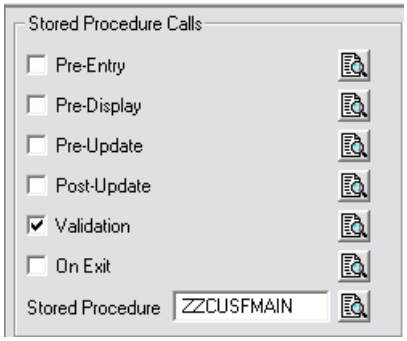

Figure 3-36 ZZCUSFMAINS1 stored procedure calls

3.10.3 Reviewing the re-engineered stored procedure source code

The ZZCUSFMAIN stored procedure consists of an ILE RPG module saved in source file QRPGLESRC in the CMS cross-reference repository on the iSeries. It contains the business rule extracted from the CUSFMAINT display program, divided into functional areas. Each business rule is implemented as a section of ILE RPG logic and preceded by a comment section giving an English description of the business rule.

To view the source code for the stored procedure ZZCUSFMAIN in the X-Analysis client, perform the following steps:

1. Locate and right-click **ZZCUSFMAIN** under Component Source Member in the Re-engineered Programs View of the X-Analysis client.
2. Select **Zoom Source**.

3. Scroll down to the Validation subroutine to review the validation business rules (Figure 3-37).

```
21.00      C*?VALIDATION
22.00      C*************************************************************************
23.00      C     zvalids1      begsr
24.00 ?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/202 Validation.
25.00 ?@!BRC*  V00001  CUSF        CNAME       You must enter the customer name.
26.00 ?=!BRC*  If the field "Company" is blank then it is invalid.
27.00      C*?Customer name
28.00      C                   if        CNAME = *blanks
29.00      C* Return message: "You must enter the customer name."
30.00      C                   eval      n1 = n1 + 1
31.00      C                   if        n1 <= 20
32.00      C                   eval      rtnflds(n1) = 'CNAME'
33.00      C                   eval      rtnmsgids(n1) = 'OEM0012'
34.00      C                   eval      rtnmsgtp  = 'E'
35.00      C                   endif
36.00      C                   endif
37.00 ?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/211 Validation.
38.00 ?@!BRC*  V00002  CUSF        TELNO       The telephone no. is invalid.
39.00 ?=!BRC*  If the field "Phone" is not blank , verify the field "Phone" against '
40.00 ?=!BRC*  0123456789'. If other values found then the field "Phone" is invalid.
41.00      C*?Telephone number
42.00      C                   if        TELNO <> *blanks
43.00      C     ' 0123456789' check     TELNO         z1
44.00      C                   if        %found
45.00      C* Return message: "The telephone no. is invalid."
46.00      C                   eval      n1 = n1 + 1
47.00      C                   if        n1 <= 20
48.00      C                   eval      rtnflds(n1) = 'TELNO'
49.00      C                   eval      rtnmsgids(n1) = 'OEM0014'
50.00      C                   eval      rtnmsgtp  = 'E'
51.00      C                   endif
52.00      C                   endif
53.00      C                   endif
```

Figure 3-37 ZZCUSFMAIN validation code

Attention: If the existing application display program was written in OPM RPG instead of ILE RPG, the resulting stored procedure will also be in OPM RPG, and will be stored in the QRPGSRC file.

3.11 Customizing the re-engineered function definitions

The RFDs AZCUSFSELS1 and ZZCUSFMAINS1 provide the functionality of the existing application programs CUSFSEL and CUSFMAINT. Each RFD requires minor customization to more closely match the existing application display programs. After customization, these RFDs are used in the re-engineered application to provide the same functionality as CUSFSEL and CUSFMAINT.

3.11.1 Customizing the Grid RFD

To customize the Grid RFD AZCUSFSELS1, follow these steps:

1. In the left pane of the X-Analysis client window, locate and expand the **CUSTSYS** application area under the CMS cross-reference repository.
2. In the expanded CUSTSYS application area, double-click **Re-engineered Program & Screens**.

3. Locate and right-click **AZCUSFSELS1** under Screen Function Name in the Re-engineered Programs View of the X-Analysis client.
4. Select **Function Layout**. The window display for the AZCUSFSELS1 function definition appears.
5. Click the Function Designer button on the toolbar.
6. The function definition editor opens in the lower pane of your window.
7. To change the header text for the customer number, select the **Field Layout** tab and perform the following steps:
   a. Click the row containing **CUSF.CUSNO**.
   b. Enter `Customer Number` in the column heading field.
8. To add the telephone number and e-mail address to the grid (Figure 3-38).
   a. Select the **Field Inclusion** tab and perform the following steps:
      i. Select **CUSF.TELNO** in the Potential Fields list.
      ii. Press the Control key and select **CUSTF.USERNM** in the Potential Fields list.
      iii. Press the Control key and select **CUSTF.EMAIL** in the Potential Fields list.
      iv. Click **Add**.

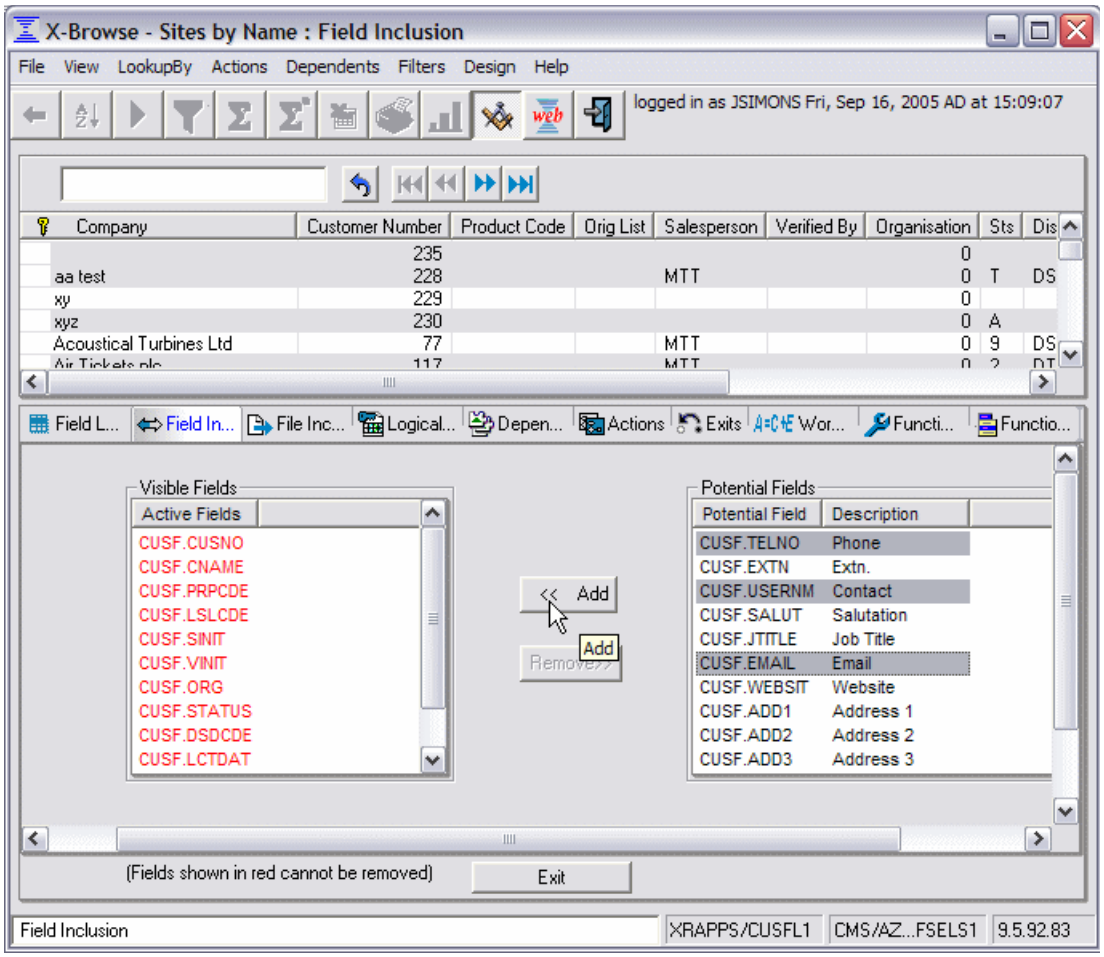

Figure 3-38 AZCUSFSELS1 field inclusion

b. Select the **Field Layout** tab and perform the following steps:

i. Select **CUST.USERMN** and enter `2.1` into the Seq column.

ii. Select **CUST.TELNO** and enter `2.2` into the Seq column.

iii. Select **CUST.EMAIL** and enter `2.3` into the Seq column.

iv. Click **OK**.

9. Allow entry into the single record format in update mode, and enable Add and Delete:

a. Select the **Function Maintenance** tab (Figure 3-39).

b. Perform the following steps in the Default Authorities area:

i. Select **Allow Update**.

ii. Select **Allow Add**.

iii. Select **Allow Delete**.

iv. Click **OK**.

c. Clear the **Simple Grid** check box in the Control Flags area.

> **Note:** The simple grid check box has no effect when working with the function layout, but will control some aspects of how a function is rendered as a Web page. Simple grids do not display full toolbars or add/edit/delete functionality.

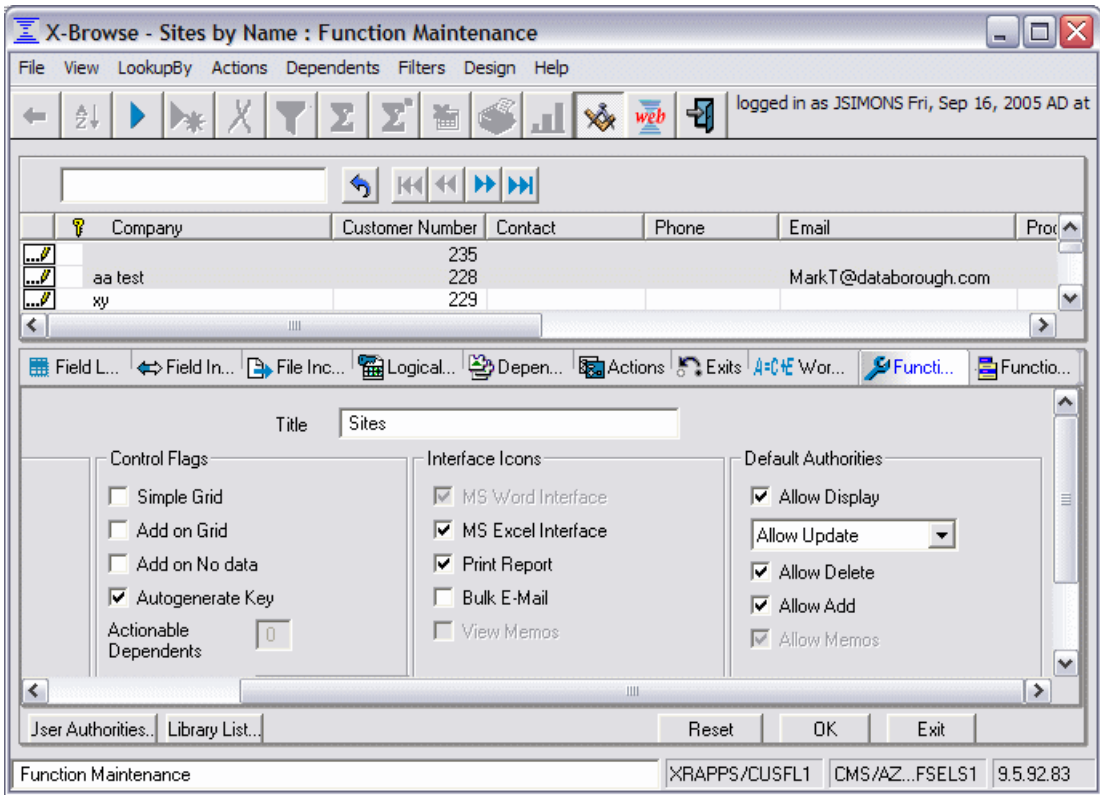

Figure 3-39 AZCUSFSELS1 function maintenance

10. Add the links for the Customers Main Menu (Figure 3-2 on page 42):
    a. Select the **Function Menu** tab.
    b. Add the link for Option 2 - Organisation Maintenance:
        i. Click **Add Menu Option**.
        ii. The Add Menu Option dialog box appears. Select **Function** in the Action field.
        iii. Select **AZORGMNTS1 (Maintain Organisation)** in the Function field.
        iv. Click **OK**.
        v. The Menu Properties dialog box appears. Click **OK**.
    c. Add the link for Option 3 - Account Maintenance:
        i. Click **Add Menu Option**.
        ii. The Add Menu Option dialog box appears. Select **Record** in the Action field.
        iii. Select **ZZCUS002S1 (MAINTAIN ACCOUNTS)** in the Function field.
        iv. Enter `Maintain Accounts` in the Caption field.
        v. Click **OK**.
        vi. The Menu Properties dialog box appears. Enter `3` in the No of Keys to Prompt field.
        vii. Click **OK**.
    d. Add the link for Option 4 - Work with Customer Contacts:
        i. Click **Add Menu Option**.
        ii. The Add Menu Option dialog box appears. Select **Function** in the Action field.
        iii. Select **AACNTACS (Contacts)** in the Function field.
        iv. Enter `Work with Customer Contacts` in the Caption field.
        v. Click **OK**.
        vi. The Menu Properties dialog box appears. Click **OK**.

        Note: We will not add a link for Option 5 - Work with Customer Sites because this function definition has been customized to replace the functionality originally implemented under that option.

    e. Add the link for Option 6 - Work with Rep. Delivery Areas:
        i. Click **Add Menu Option**.
        ii. The Add Menu Option dialog box appears. Select **Function** in the Action field.
        iii. Select **AZWWRAREASS1 (Work with Rep. Delivery Areas)** in the Function field.
        iv. Click **OK**.
        v. The Menu Properties dialog box appears. Click **OK**.
11. Click **Exit** to close the function definition editor, and review the final function definition (Figure 3-40 on page 77).

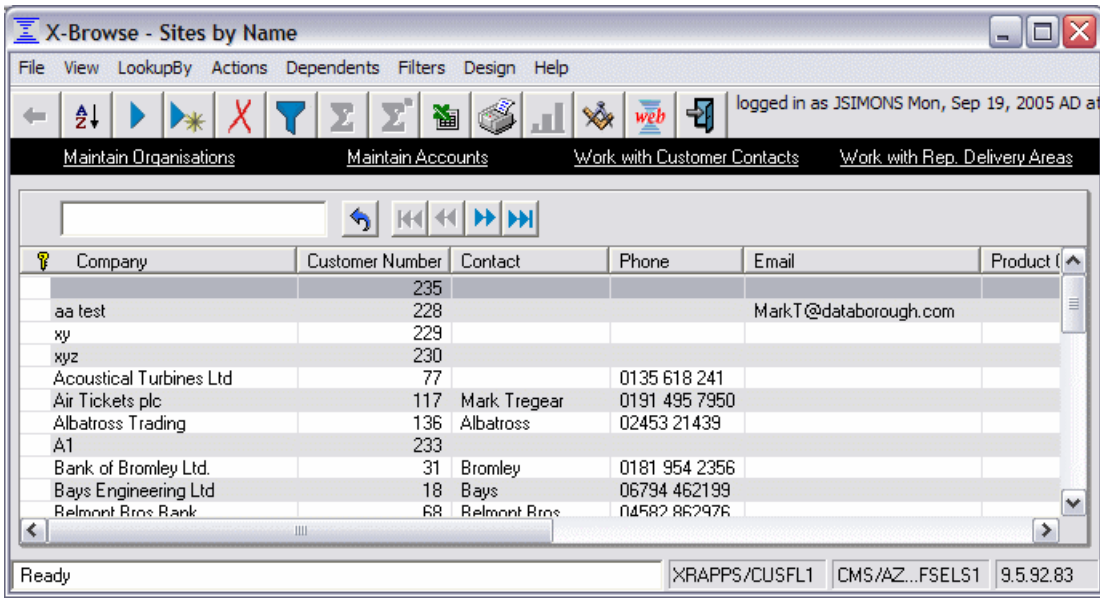

Figure 3-40 Final layout for format AZCUSFSELS1

The add, delete, and update functionality can be accessed using the new buttons that appear on the format layout:

Update

Add

Delete

You can click the various buttons to demonstrate how control flows between layouts. Click the Back button on the toolbar to return to the previous window. When you are done reviewing the layout, close the X-Browse - Sites by Name window to return to the X-Analysis client.

3.11.2 Customizing the Flat Screen RFD

To customize the Flat Screen RFD ZZCUSFMAINS1, follow these steps:

1. Locate and right-click **ZZCUSFMAINS1** under Screen Function Name in the Re-engineered Programs View of the X-Analysis client.
2. Select **Function Layout**. The window display for the ZZCUSFMAINS1 function definition appears.
3. Click the Function Designer button on the toolbar.
4. The function definition editor opens in the lower pane of your window. To correct the header text for the customer number, select the **Field Layout** tab and perform the following steps:
   a. Click the row containing the Field **CUSF.CUSNO**.
   b. Enter `Customer Number` in the Constant / Field Name column.
   c. Enter `2` in the Column column.
5. To remove the data display work field, select the **Field Inclusion** tab and perform the following steps:
   a. Select **<Work Field>ZZDATE** in the Visible Fields list.

b. Click **Remove**.

6. To move the address line out of the header, select the **Function Maintenance** tab and perform the following steps:
   a. Enter `3` in the Header Dividing Line No. field.
   b. Click **OK**.
7. To enable add functionality, select the **Function Maintenance** tab and perform the following steps:
   a. Select **Allow Add** in the Default Authorities group.
   b. Click **OK**.
8. Separate the distributor and salesperson fields: Select the **Field Layout** tab and perform the following steps:
   a. Select the **Distributor, Salesperson** row.
   b. Enter `Distributor` in the Constant / Field Name column.
   c. Select the **SINT** row.
   d. Enter `21` in the row number.
   e. Enter `28` in the column number.
   f. Click **OK**.
   g. Select the **Drag and Drop** tab (Figure 3-41) and perform the following steps:
      i. Enter `21` in the Row field.
      ii. Enter `2` in the Column field.
      iii. Enter `Salesperson` in the New Constant field.
      iv. Click **Add**.
      v. Click **OK**.

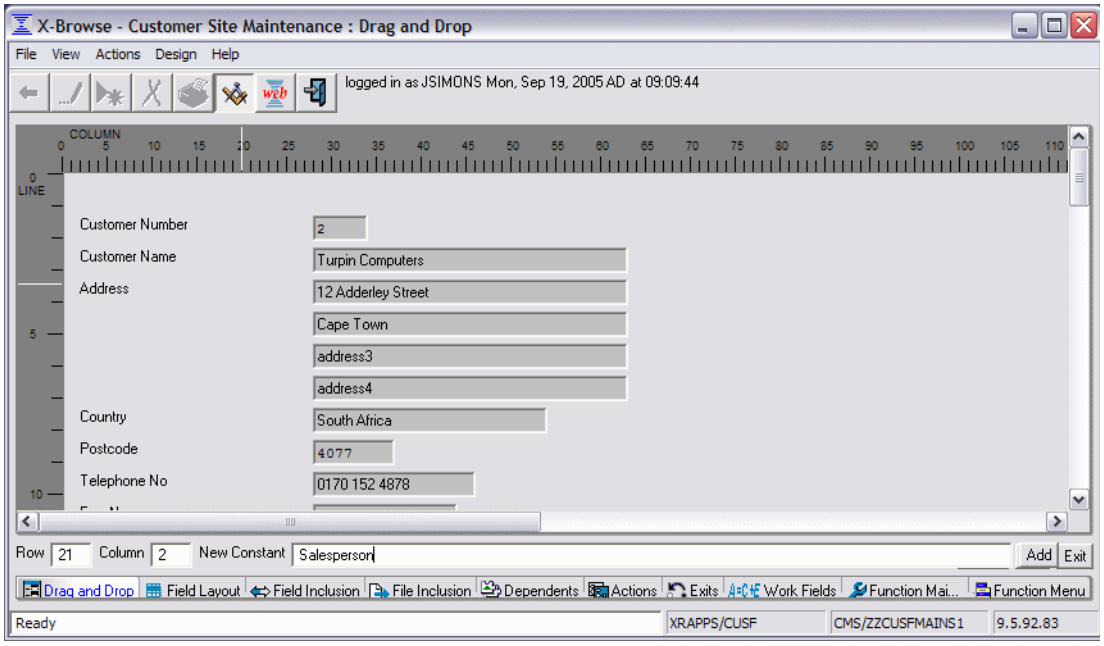

Figure 3-41 ZZCUSFMAINS1 Drag and Drop tab

9. Add the description field for the distributor and the status code:
   a. Select the **Field Inclusion** tab and perform the following steps:
      i. Select **ASTATUS.STSTXT** in the Potential Fields list.
      ii. Press the Control key and select **DIST.DNAME** in the Potential Fields list.
      iii. Click **Add**.
   b. Select the **Field Layout** tab and perform the following steps:
      i. Select the **DNAME** row.
      ii. Enter 14 in the row number.
      iii. Enter 35 in the column number.
      iv. Select the **STSTXT** row.
      v. Enter 15 in the row number.
      vi. Enter 35 in the column number.
      vii. Click **OK**.
      viii. Select the **Status Text** row. Select **Delete**.
      ix. Select the **Description row**. Select **Delete**.
      x. Click **OK**.
10. Remove the Work with Distributors dependent button, as the distributor description now shows on the General window. Select the **Dependents** tab and perform the following steps:
   a. Select the ZADISTS function. Select **Delete**.
   b. Click **OK**.
11. Click **Exit** to close the function definition editor, and review the final function definition (Figure 3-42 on page 80). When you are through reviewing the layout, close the X-Browse - Site Maintenance window to return to the X-Analysis client.

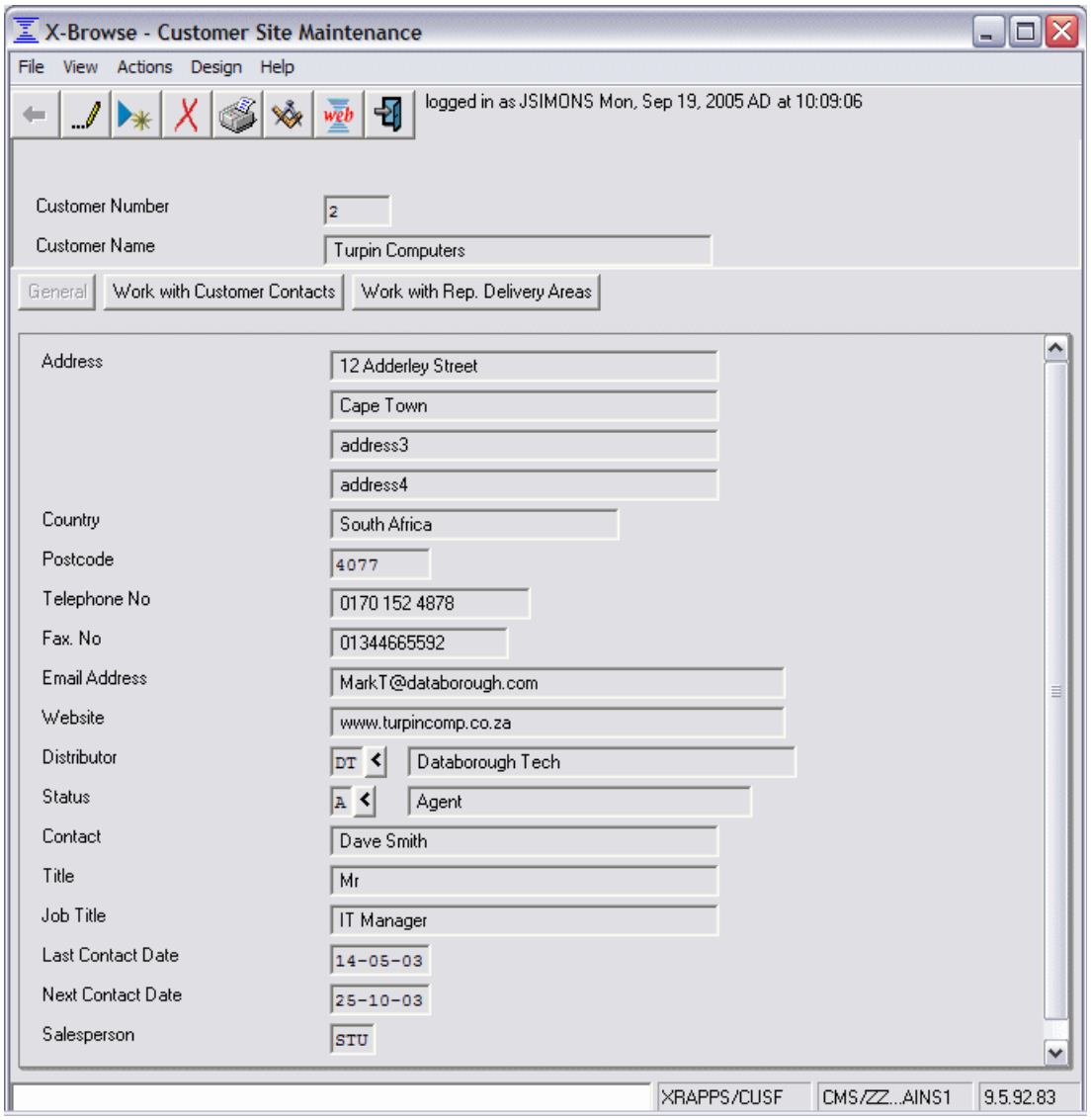

Figure 3-42 Final layout for format ZZCUSTFMAINS1

3.12 Web-enabling the application using the X-Web framework

The X-Web framework uses the metadata stored in each function definition to manage the View and Controller components. The required Views are built dynamically on demand by X-Web framework. The X-Web framework manages:

- Building each requested View
- Flow of control between the Views
- Calls to the stored procedures associated with each function definition

You use the X-Web server to execute the re-engineered Web-enabled application. The X-Web server dynamically interprets the standard and re-engineered function definitions, and builds the Web pages as needed. Maintenance changes to the Web pages are implemented by changing the underlying function definition or the configuration setting in the X-Web framework.

3.12.1 Starting and configuring the X-Web server

In order to view and test the Web-enabled application, you must create a test site on the X-Web server, and link to that site to navigate the application. For development purposes, the X-Web server runs on your PC. To correctly set up the X-Web sever to host the sample application, perform the following steps.

1. Select **Start** → **Programs** → **X-Web** → **Start X-Web Server** to start the X-Web server on your PC.
2. Select **Start** → **Programs** → **X-Web** → **Create Site Definition** to create a test site definition.
3. In the X-Web Site Administration dialog box (Figure 3-43), click **OK**.

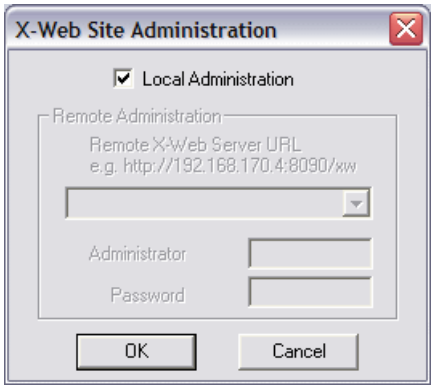

Figure 3-43 X-Web Site Administration dialog box

4. In the Basic Site Configurator dialog box (Figure 3-44), perform the following steps in the X-Ref/Application settings area:
   a. Select **DB400** in the Database Type field.
   b. Enter the IP address or domain name of your iSeries in the IP Address field.
   c. Enter your iSeries User ID in the User ID field.
   d. Enter your iSeries password in the password and confirm password fields.
   e. Enter `CMS` in the Function Library field.
   f. Enter your application and data libraries (`CMS` and `XRRAPPS`) in the Library List field prior to the existing XREV library.
5. Click **Get Eligible Pages** in the Entry Page area:
   a. On the Site Eligible Pages dialog box, select **AZCUSFSELS1 Sites**.
   b. Click **OK**.
6. Click the Save button on the toolbar.

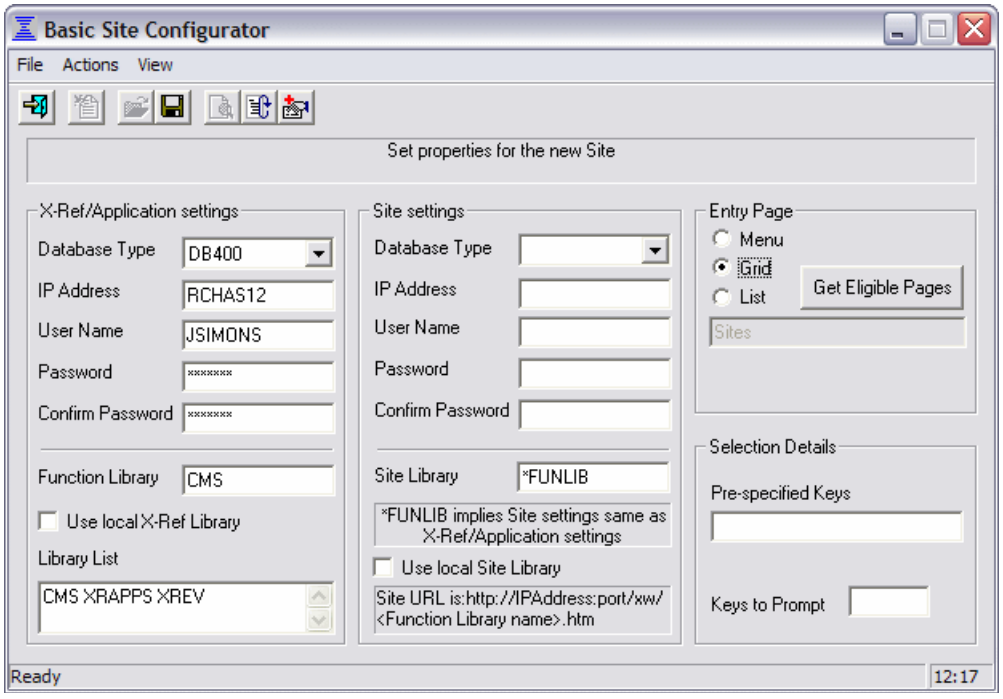

Figure 3-44 X-Web Basic Site Configurator dialog box

7. A message box appears with the message `cms site Started`. Click **OK**.
8. A message box appears with the message `Logged out sucessfully`. Click **OK**.

3.12.2 The Web-enabled application Web pages

To start the Web-enabled application, perform the following steps:

1. Select **Start** → **Programs** → **X-Web** → **Test Sites** to launch the browser.
2. In the browser window (Figure 3-45), enter your X-Web login information. This is the user ID and password you set up in your site definition. Click **Sign In**.

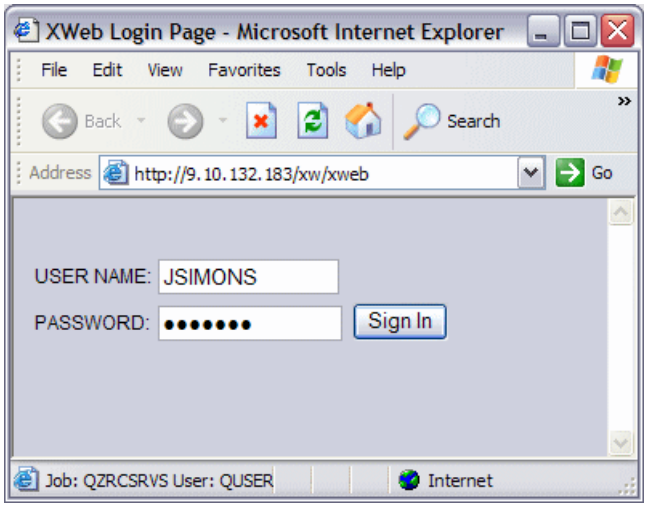

Figure 3-45 X-Web login page

Customer sites maintenance Web pages

When you enter the application, the Customer Site Maintenance Selection Web page (Figure 3-46) appears. In the re-engineered application, this page combines the functionality of the Customers Main Menu display program (Figure 2-1 on page 17), the Customer Site Maintenance display program (Figure 2-2 on page 18), and the Work with Customer Sites display program (Figure 2-21 on page 26).

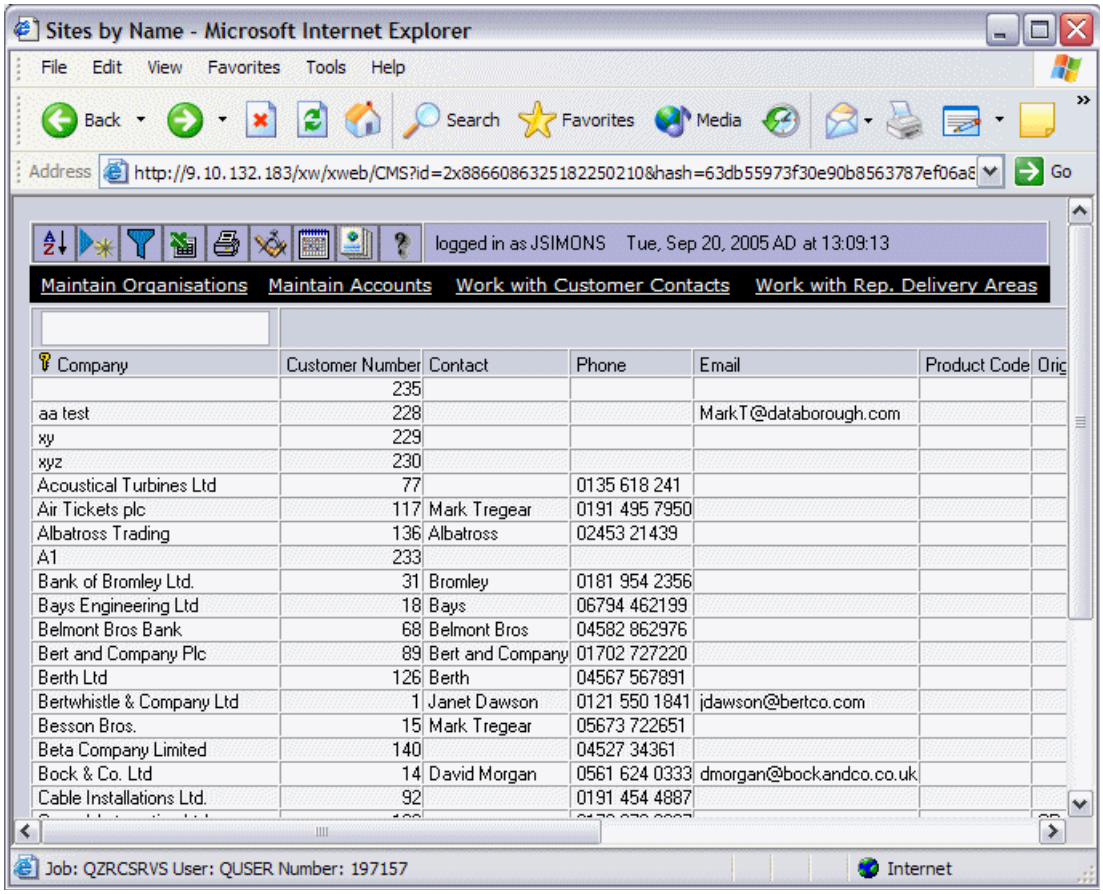
Sites by Name - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?id=2x886608632518225021O&hash=63db55973f30e90b8563787ef06a8
Go
logged in as JSIMONS Tue, Sep 20, 2005 AD at 13:09:13
Maintain Organisations Maintain Accounts Work with Customer Contacts Work with Rep. Delivery Areas
Company Customer Number Contact Phone Email Product Code Orig
235
aa test 228 MarkT@databorough.com
xy 229
xyz 230
Acoustical Turbines Ltd 77 0135 618 241
Air Tickets plc 117 Mark Tregear 0191 495 7950
Albatross Trading 136 Albatross 02453 21439
A1 233
Bank of Bromley Ltd. 31 Bromley 0181 954 2356
Bays Engineering Ltd 18 Bays 06794 462199
Belmont Bros Bank 68 Belmont Bros 04582 862976
Bert and Company Plc 89 Bert and Company 01702 727220
Berth Ltd 126 Berth 04567 567891
Bertwhistle & Company Ltd 1 Janet Dawson 0121 550 1841 jdawson@bertco.com
Besson Bros. 15 Mark Tregear 05673 722651
Beta Company Limited 140 04527 34361
Bock & Co. Ltd 14 David Morgan 0561 624 0333 dmorgan@bockandco.co.uk
Cable Installations Ltd. 92 0191 454 4887
Job: QZRCSRVS User: QUSER Number: 197157
Internet

Figure 3-46 Customer Site Maintenance Selection Web page (AZCUSFSELS1)

The Customer Site Maintenance Selection Web page is built from the AZCUSFSELS1 function definition (Figure 3-40 on page 77), which was defined as the entry page for our application when the CMS site definition was created (Figure 3-44 on page 82). The links for the remaining menu items from the Customers Main Menu are displayed at the top of the page under the toolbar.

Tips:

- If the toolbar does not show up on the grid, make sure the function is not defined as a Simple Grid (See 3.11.1, “Customizing the Grid RFD” on page 73 for more information.)
- The page up and page down buttons are formatted to be on the far right side of the screen. If they are not visible, scroll horizontally to bring them into view.

In the selection window, click on the Company text of an individual record to bring up a single record display (Figure 3-47).

Attention: When you worked with a grid function displayed in the function layout, you could click anywhere in a grid row to access the single record display. However, when working with a grid function displayed on a Web page, the link behavior more closely follows the hyperlink standard. Only the actual text in the first column acts as a link to the single record format. If you click elsewhere in the row, it will have no effect.

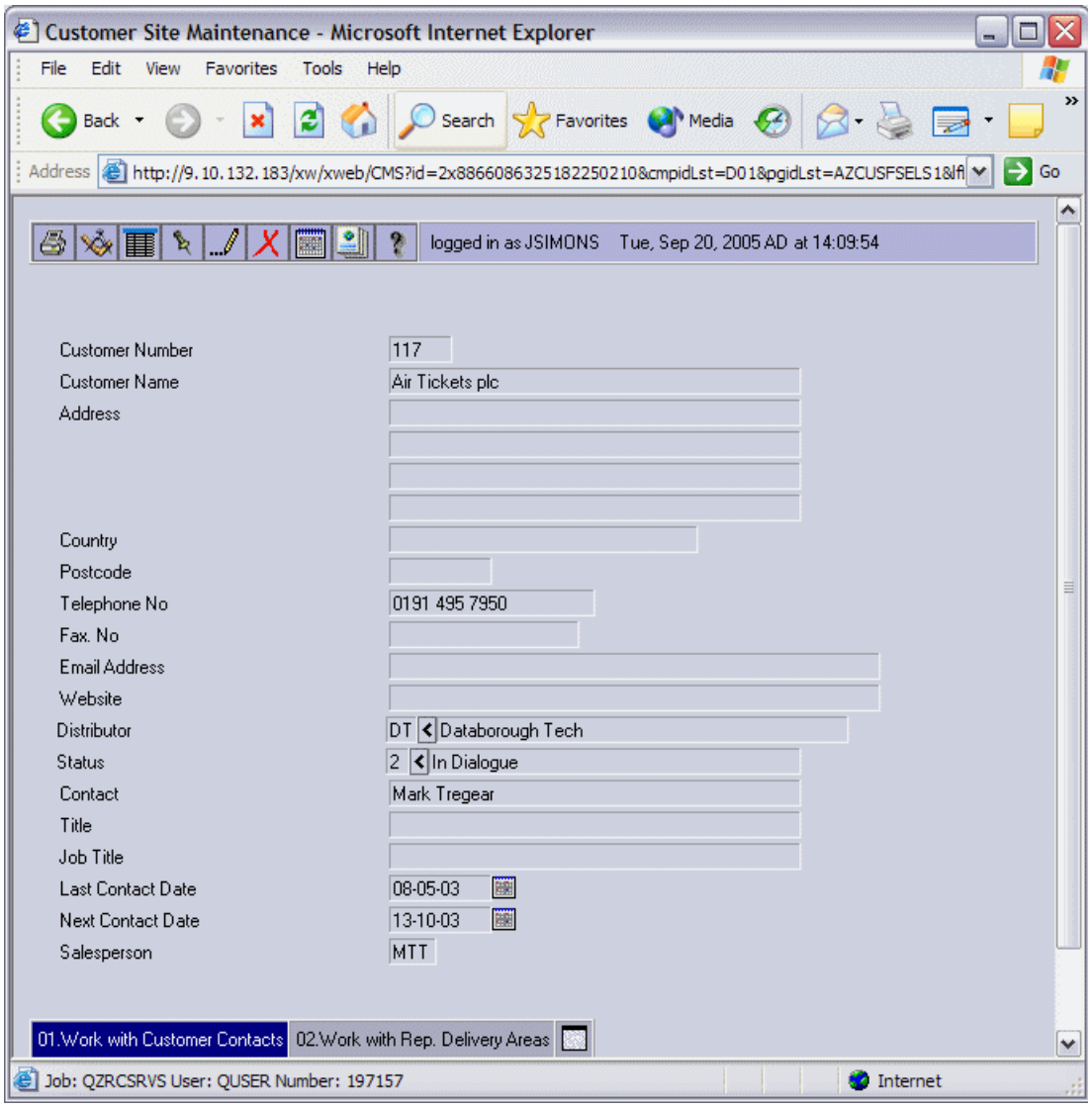

Figure 3-47 Customer Site Maintenance Single Record Web page (ZZCUSFMAINS1)

The Customer Site Maintenance Single Record Web page is built from the ZZCUSFMAINS1 function definition (Figure 3-42 on page 80). It corresponds to the single record site display in the existing application (Figure 2-4 on page 19). The toolbar buttons give access to the edit and delete functions. Record validations are handled by the stored procedure ZZCUSFMAIN.

Click the Back button in your Web browser or the List button on the toolbar to return to the Customer Site Maintenance Selection Web page.

Organisation maintenance Web pages

Click **Maintain Organisations** on the Customer Site Maintenance Selection Web page to bring up the Maintain Organisation Selection Web page (Figure 3-48). This page implements the functionality of the existing application's Organisation Maintenance display program (Figure 2-11 on page 22).

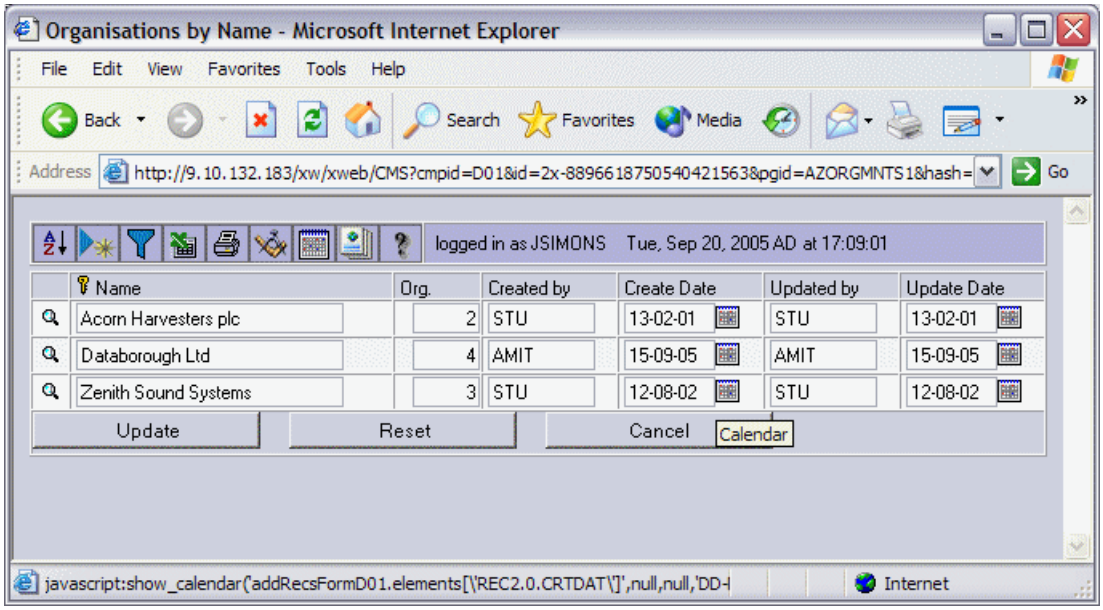
Organisations by Name - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?cmpid=D01&id=2x-8896618750540421563&pgid=AZORGMNTS1&hash= Go
logged in as JSIMONS Tue, Sep 20, 2005 AD at 17:09:01
Name Org. Created by Create Date Updated by Update Date
Acorn Harvesters plc 2 STU 13-02-01 STU 13-02-01
Databorough Ltd 4 AMIT 15-09-05 AMIT 15-09-05
Zenith Sound Systems 3 STU 12-08-02 STU 12-08-02
Update Reset Cancel Calendar
javascript:show_calendar('addRecsFormD01.elements[\'REC2.0.CRTDAT\']',null,null,'DD-
Internet

Figure 3-48 Maintain Organisations Selection Web page (AZORGMNTS1)

Note: The Simple Grid check box of the automatically generated AZORGMNTS1 function definition was cleared in the function definition editor to get the page shown in Figure 3-48.

As with the existing display application, this Web page provides an editable grid that enables direct editing of the displayed fields. The Add button on the toolbar is used to add additional records. Display and delete functionality is available from the single record Web page.

Click the **View** button beside a record to view the single record Web page (Figure 3-49).

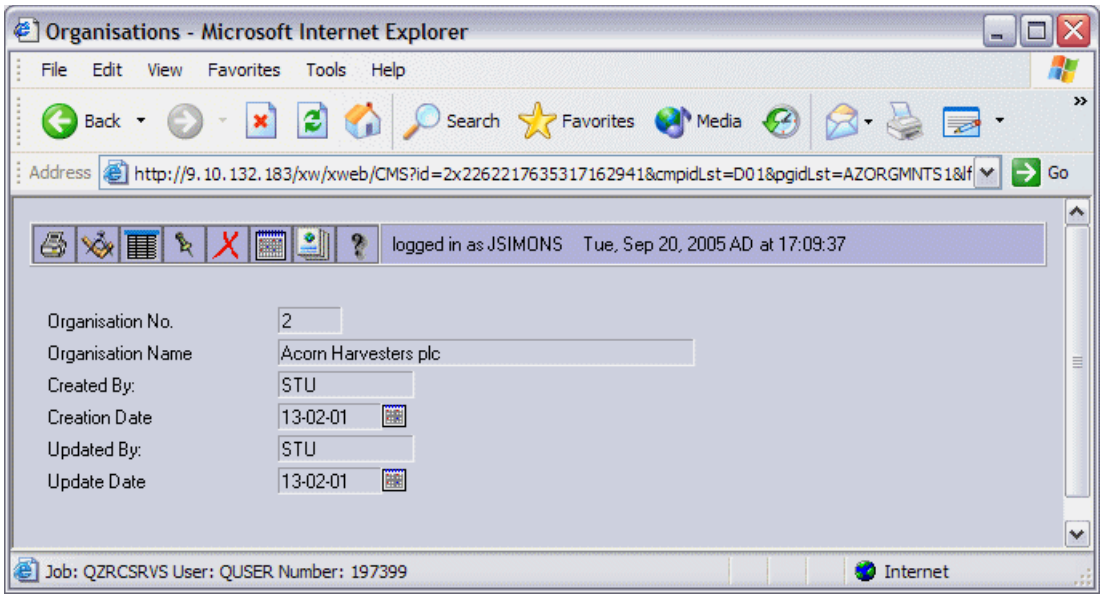
Organisations - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?id=2x2262217635317162941&cmpidLst=D01&pgidLst=AZORGMNTS1&lf
Go
logged in as JSIMONS Tue, Sep 20, 2005 AD at 17:09:37
Organisation No. 2
Organisation Name Acorn Harvesters plc
Created By: STU
Creation Date 13-02-01
Updated By: STU
Update Date 13-02-01
Job: QZRCSRVS User: QUSER Number: 197399
Internet

Figure 3-49 Maintain Organisations Single Record Web page (ZAORGS)

Note: Some minor customizations with the function definition editor were made to the automatically generated ZAORGS function definition to achieve the page in Figure 3-49:

- The default function menu items were removed.
- The default dependent view for related sites was removed.
- The update functionality was removed.

The Maintain Organisations Single Record Web page is built from the standard function definition ZAORGS that was automatically created during the data modeling process. This provides the add and delete functionality of the existing application single record screen (Figure 2-12 on page 22).

Click the Back button in your browser once to return to the Maintain Organisation Selection Web page, and a second time to return to the Customer Site Maintenance Selection Web page.

Account maintenance Web pages

Click **Maintain Accounts** on the Customer Site Maintenance Selection Web page to bring up the Account Maintenance Web pages. These Web pages implement the functionality of the existing application's Account Maintenance display program. Unlike the other options, the account maintenance screen does not start with a selection screen. Instead, it prompts for three key fields (Figure 2-14 on page 23), and then displays the record directly associated with those key fields (Figure 2-15 on page 23).

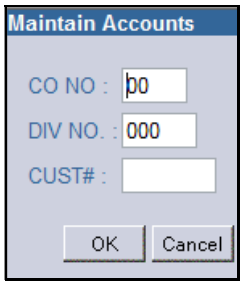

Figure 3-50 Maintain Accounts prompt

The Maintain Accounts prompt (Figure 3-50) provides the functionality of the existing application's initial Account Maintenance prompt screen (Figure 2-14 on page 23). The prompt was created automatically when you specified three key fields while creating the links on the ZZCUSFSELS1 function definition (See page 76).

In the Maintain Accounts prompt:

1. Enter 1 for CO NO.
2. Enter 1 for DIV NO.
3. Enter 1 for CUST#.
4. Click **OK**.

   The Maintain Accounts Web page (Figure 3-51 on page 89) appears.

   The top portion of the Maintain Accounts Web page is built from the re-engineered function definition ZZCUS002S1, and provides the functionality of the existing application's Maintain Account display (Figure 2-15 on page 23).

   The display of the bottom portion of the Maintain Accounts Web page is controlled by links in the center of the page. When the page is initially displayed, the `01.Account Masters` link is active, and the RFD ZZCUS002S2 is rendered on the bottom of the page.

Note: Some minor customizations with the function definition editor were made to the automatically generated ZZCUS002S1 and ZZCUS002S2 function definitions to achieve the Web page shown in Figure 3-51:

- The existing application used a turquoise field color for all the data fields. This was included in the RFD. The field colors were manually changed to black and blue.
- Minor changes were made to the field layout.

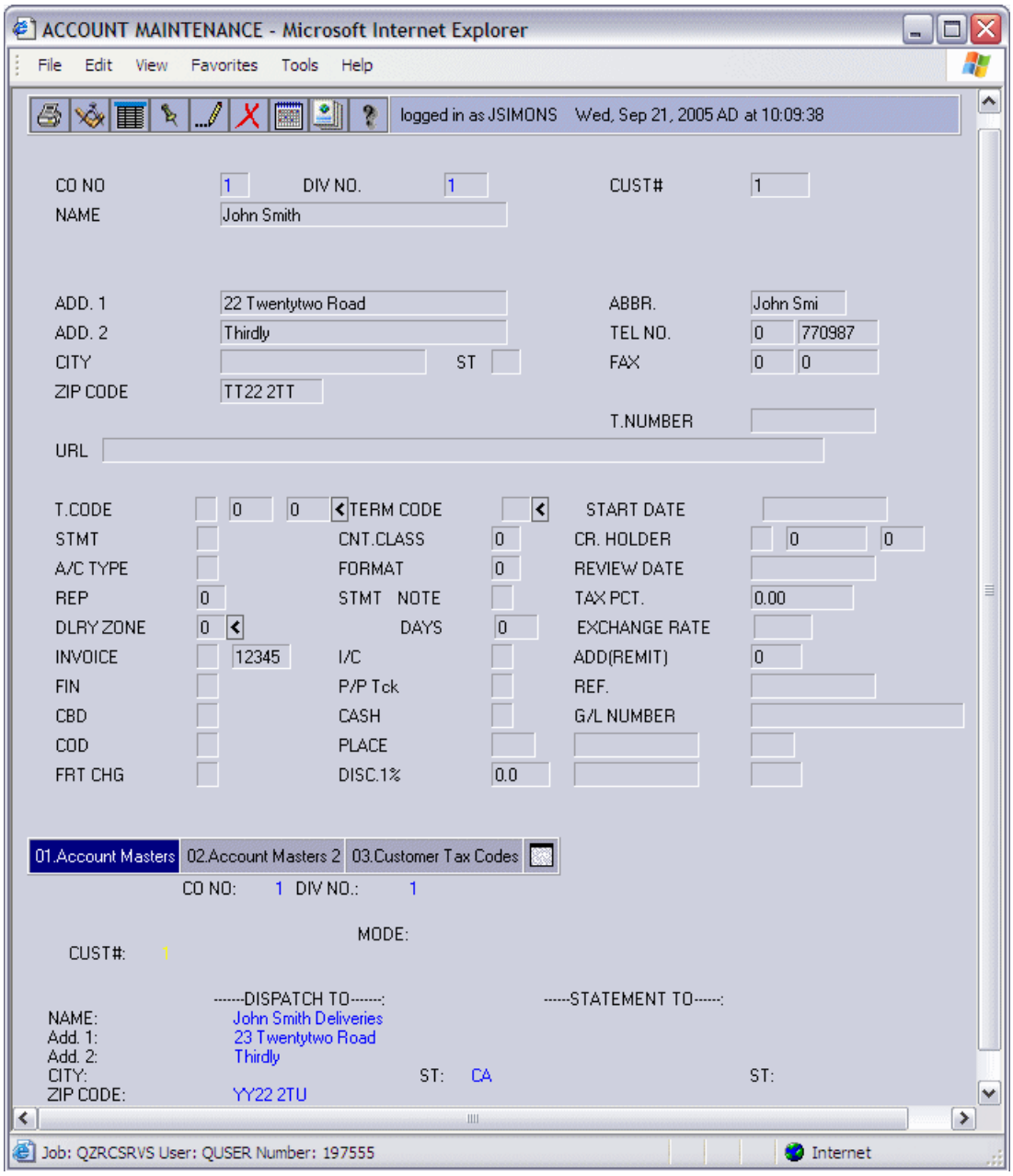
ACCOUNT MAINTENANCE - Microsoft Internet Explorer
File Edit View Favorites Tools Help
logged in as JSIMONS Wed, Sep 21, 2005 AD at 10:09:38
CO NO 1 DIV NO. 1 CUST# 1
NAME John Smith
ADD. 1 22 Twentytwo Road ABBR. John Smi
ADD. 2 Thirdly TEL NO. 0 770987
CITY ST FAX 0 0
ZIP CODE TT22 2TT
T.NUMBER
URL
T.CODE 0 0 TERM CODE START DATE
STMT CNT.CLASS 0 CR. HOLDER 0 0
A/C TYPE FORMAT 0 REVIEW DATE
REP 0 STMT NOTE TAX PCT. 0.00
DLRY ZONE 0 DAYS 0 EXCHANGE RATE
INVOICE 12345 I/C ADD(REMIT) 0
FIN P/P Tck REF.
CBD CASH G/L NUMBER
COD PLACE
FRT CHG DISC.1% 0.0
01.Account Masters 02.Account Masters 2 03.Customer Tax Codes
CO NO: 1 DIV NO.: 1
MODE:
CUST#: 1
-------DISPATCH TO-------: -------STATEMENT TO-------:
NAME: John Smith Deliveries
Add. 1: 23 Twentytwo Road
Add. 2: Thirdly
CITY: ST: CA ST:
ZIP CODE: YY22 2TU
Job: QZRCSRVS User: QUSER Number: 197555
Internet

Figure 3-51 Maintain Accounts Web page (ZZCUS002S1)

5. Select **02.Account Masters 2** to render the ZZCUS002S3 RFD on the bottom of the Maintain Accounts Web page. Select **03.Customer Tax Codes** to render the ZZCUS002S4 RFD on the bottom of the Maintain Accounts Web page. These RFDs correspond to the additional screens of the existing application's Account Maintenance display program.
6. Click the Back button in your Web browser until you return to the Customer Site Maintenance Selection Web page.

Work with Customer Contacts Web pages

Click **Work with Customer Contacts** on the Customer Site Maintenance Selection Web page to open the Customer Contacts Selection Web page (Figure 3-52). This page implements the functionality of the existing application's Work with Customer Contacts display program.

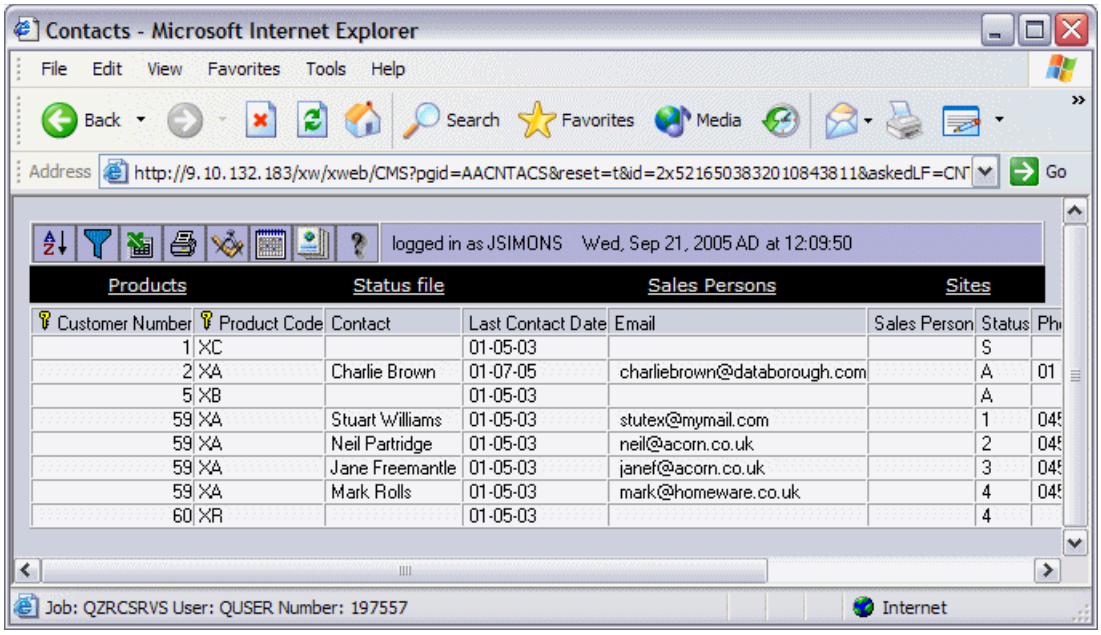
Contacts - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?pgid=AACNTACS&reset=t&id=2x52165038320108438118askedLF=CN
Go
logged in as JSIMONS Wed, Sep 21, 2005 AD at 12:09:50
Products Status file Sales Persons Sites
Customer Number Product Code Contact Last Contact Date Email Sales Person Status
1 XC 01-05-03 S
2 XA Charlie Brown 01-07-05 charliebrown@databorough.com A 01
5 XB 01-05-03 A
59 XA Stuart Williams 01-05-03 stutex@mymail.com 1
59 XA Neil Partridge 01-05-03 neil@acorn.co.uk 2
59 XA Jane Freemantle 01-05-03 janef@acorn.co.uk 3
59 XA Mark Rolls 01-05-03 mark@homeware.co.uk 4
60 XR 01-05-03 4
Job: QZRCSRVS User: QUSER Number: 197557
Internet

Figure 3-52 Customer Contacts Selection Web page (AACNTACS)

The Customer Contacts Selection Web page is built from the standard function definition AACNTACS that was customized previously (Figure 3-16 on page 54). This provides the functionality of the existing application subfile selection screens (Figure 2-17 on page 24 and Figure 2-18 on page 25).

In the selection window, click on the Customer Number text of an individual record.

This brings up a single record display (Figure 3-47 on page 85). The Customer Contacts Single Record Web page is built from the standard function definition ZACNTACS that was previously customized (Figure 3-21 on page 59). This provides the functionality of the existing application single record display screen (Figure 2-19 on page 25).

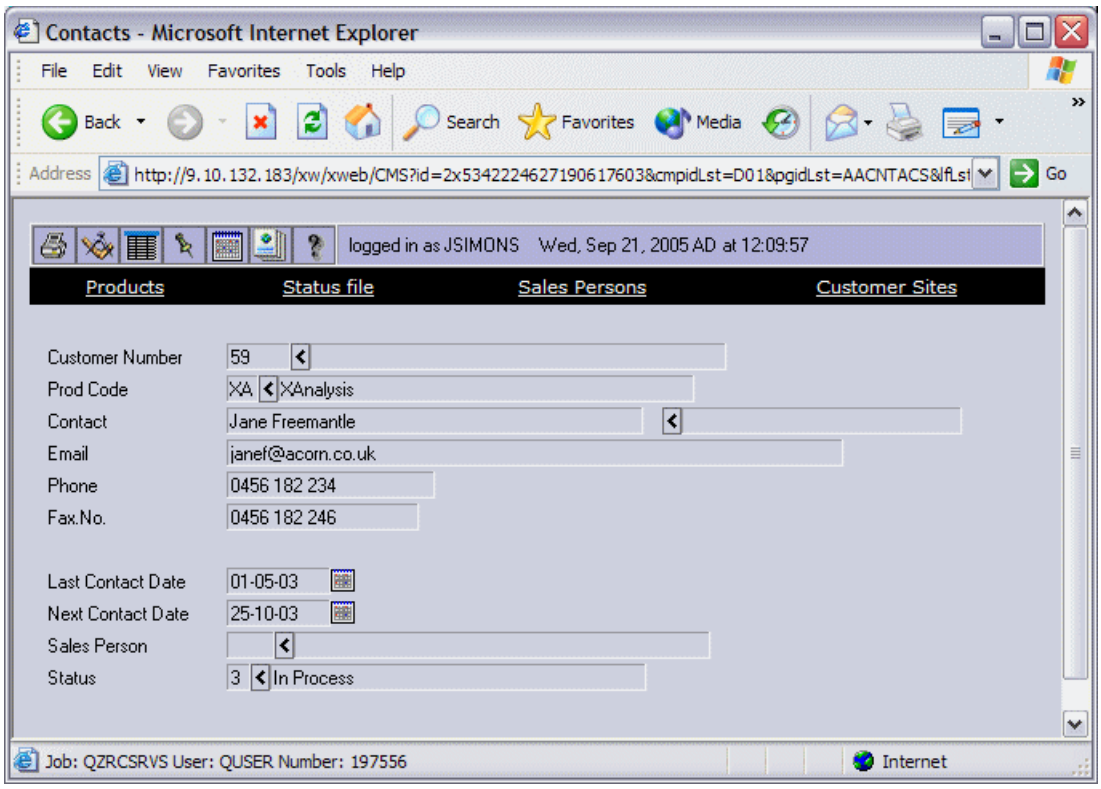
Contacts - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?id=2x534222462719061760 3&cmpidLst=D01&pgidLst=AACNTACS&lfLst
Go
logged in as JSIMONS Wed, Sep 21, 2005 AD at 12:09:57
Products Status file Sales Persons Customer Sites
Customer Number 59
Prod Code XA XAnalysis
Contact Jane Freemantle
Email janef@acorn.co.uk
Phone 0456 182 234
Fax.No. 0456 182 246
Last Contact Date 01-05-03
Next Contact Date 25-10-03
Sales Person
Status 3 In Process
Job: QZRCSRVS User: QUSER Number: 197556
Internet

Figure 3-53 Customer Contacts Single Record Web page (ZACNTACS)

Click the Back button in your browser once to return to the Customer Contacts Selection Web page, and again to return to the Customer Site Maintenance Selection Web page.

Work with Rep. Delivery Areas Web pages

Click **Work with Rep. Delivery Areas** on the Customer Site Maintenance Selection Web page to bring up the Delivery Areas Selection Web page (Figure 3-54). This Web page implements the functionality of the existing application's Work with Rep. Delivery Areas display program.

The Delivery Areas Selection Web page is built from the re-engineered function definition AZWWRAREASS1. This provides the functionality of the existing application selection list (Figure 2-26 on page 29).

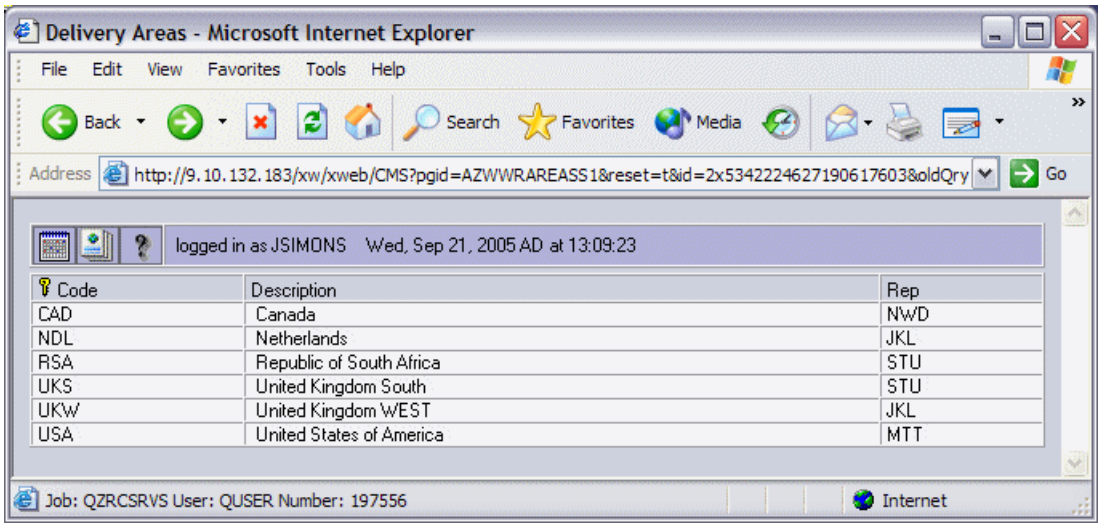
Delivery Areas - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?pgid=AZWWRAREASS1&reset=t&id=2x534222462719061760 3&oldQry
Go
logged in as JSIMONS Wed, Sep 21, 2005 AD at 13:09:23
Code Description Rep
CAD Canada NWD
NDL Netherlands JKL
RSA Republic of South Africa STU
UKS United Kingdom South STU
UKW United Kingdom WEST JKL
USA United States of America MTT
Job: QZRCSRVS User: QUSER Number: 197556
Internet

Figure 3-54 Delivery Areas Selection Web page (AZWWRAREASS1)

Click an individual record in the selection window to bring up a single record display (Figure 3-55). The Delivery Areas Single Record Web page is built from the standard function definition ZADELIVA. This provides the functionality of the existing application single record display screen (Figure 2-28 on page 29).

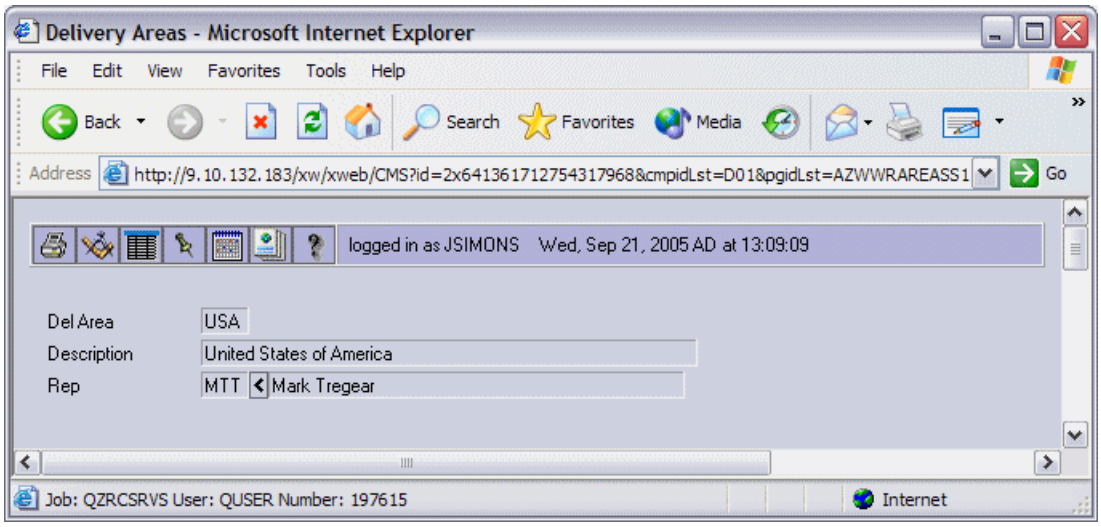
Delivery Areas - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?id=2x641361712754317968&cmpidLst=D01&pgidLst=AZWWRAREASS1
Go
logged in as JSIMONS Wed, Sep 21, 2005 AD at 13:09:09
Del Area USA
Description United States of America
Rep MTT Mark Tregear
Job: QZRCSRVS User: QUSER Number: 197615
Internet

Figure 3-55 Delivery Areas single record Web page (ZADELIVA)

Click the Back button in your Web browser once to return to the Delivery Areas selection Web page, and a second time to return to the Customer Site Maintenance selection Web page.

3.13 Implementing the Web-enabled application in Java

The recommended approach is to leave as much of the application user interface as interpreted metadata as possible. This helps ensure uniformity of styles and simplifies maintenance.

When greater control over part or all of the user interface portion of the Web-enabled application is required, selected standard and re-engineered function definitions are implemented using JavaServer Faces (JSF) technology.

We use X-Analysis to generate standard Java components (JavaServer Faces, JavaBeans, and Java abstract classes) in WDSc from the MVC re-engineered application's function definitions. These components can be edited or further customized in a Java development environment such as WDSc.

3.13.1 Java components

The X-Analysis JSF Generator (Figure 3-56) creates the standard Java components needed to implement a function definition in the form of JavaServer Faces (JSF), JavaBeans, and Java abstract classes. For documentation purposes, the correct tags are generated in the JavaBeans to allow export into Unified Modeling Language (UML).

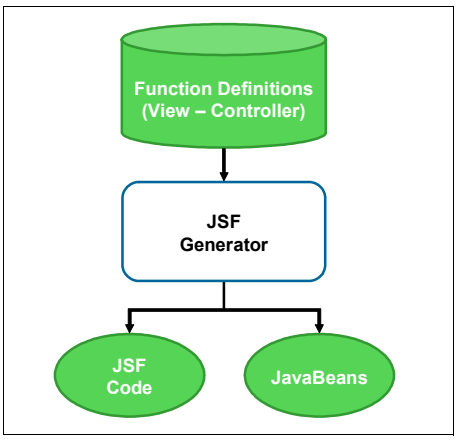

Figure 3-56 JSF Generator

JavaServer Faces

JavaServer Faces (JSF) is a standardized specification for developing Web applications with rich user interfaces. JSF technology is a user interface framework for building Java-based Web applications that run on the server side and render the user interface back to the client. One of the advantages of the JSF specification is that it is based on the Model View Controller (MVC) architecture, which offers a clean separation between presentation and logic. For more information about JavaServer Faces, refer to:

http://java.sun.com/j2ee/javaserverfaces

JavaBeans

JavaBeans technology is the component architecture for the Java 2 Platform, Standard Edition (J2SE™). JavaBeans are reusable software programs (components) that you can develop and assemble easily to create sophisticated applications. For more information about JavaBeans, refer to:

http://java.sun.com/products/javabeans/index.jsp

Java abstract classes

A Java abstract class is a class description that can never be instantiated into a specific object. Abstract classes are created so that other classes can inherit from them and implement their abstract methods. The first time an MVC re-engineering project is instanced in WebSphere, X-Analysis creates a set of Java abstract classes to provide functionality needed by the View-Controller components to provide database access and stored procedure calls. These Java abstract classes are shared between all of the WebSphere projects.

Unified Modeling Language

The Unified Modeling Language (UML) is an Object Management Group specification, to pattern application structure, behavior, and architecture, as well as business process and data structure. X-Analysis places the correct tags into the JavaBeans it creates to allow export into a UML format. The UML-formatted information can be used to build standard Java documentation. For more information about UML, refer to:

http://www.uml.org/

3.13.2 Generating the Java components

We have selected the Customer Site Maintenance Single Record Web page (Figure 3-47 on page 85) to be implemented as Java components. This Web page is currently being created interactively from the ZZCUSFMAINS1 re-engineered function definition by the X-Web framework. To generate the Java components for this function definition, perform these steps:

1. In the left pane of the X-Analysis client window, locate and expand the **CUSTSYS** application area under the CMS cross-reference repository and double-click **Re-engineered Program & Screens**.
2. Locate and right-click **ZZCUSFMAINS1** under Screen Function Name in the Re-engineered Programs View of the X-Analysis client.
3. Select **Generate JSF, Javabean(s) and UML** (Figure 3-57).

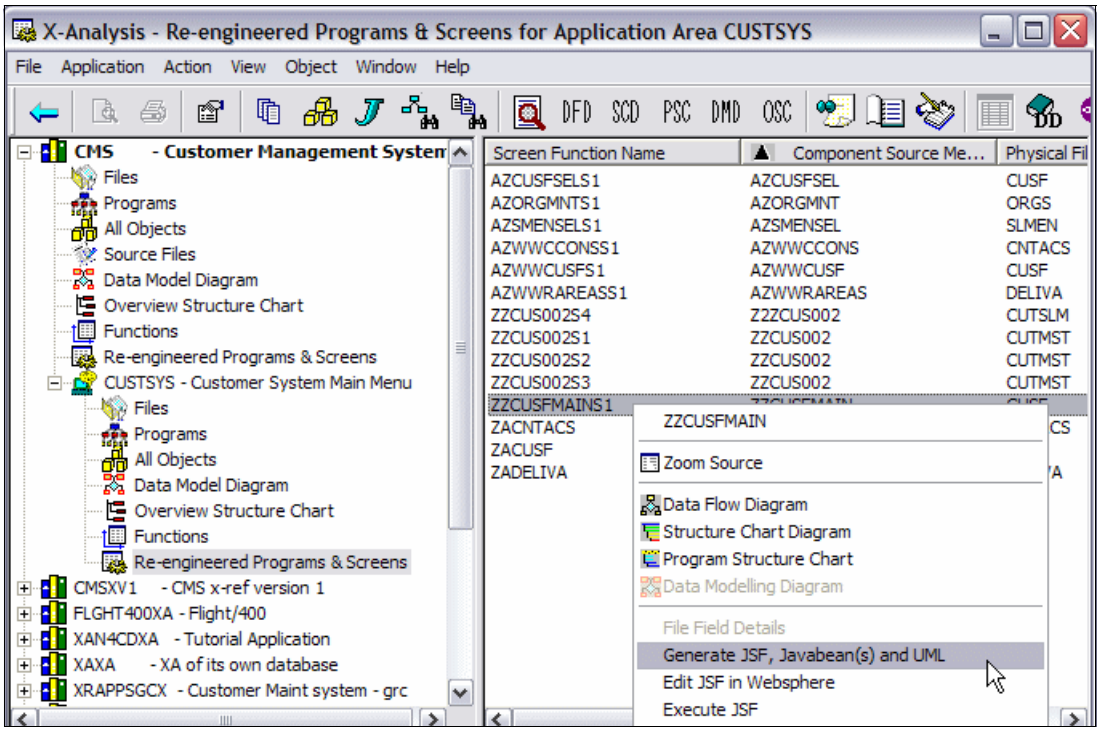

Figure 3-57 Generating JSF for RFD ZZCUSFMAINS1

4. The Generate Web Pages dialog box (Figure 3-58) appears with the message `Cms project has not been configured in WebSphere Studio`. Click **Configure**.

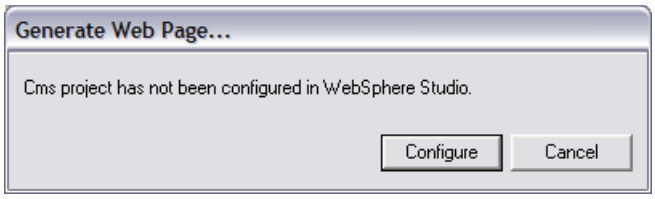

Figure 3-58 Generate Web Pages configuration dialog box

5. If you are currently running the X-Web Server on your PC, you may be prompted to stop it. Select **Start** → **Programs** → **X-Web** → **Stop X-Web Server** to stop the X-Web server.
6. The WebSphere Studio Site Developer (WSSD) will be started on your PC. This may take some time. WSSD displays a splash screen and is then minimized on your task bar.

> **Note:** WDSc is an extension to WSSD. When the WebSphere client is started automatically from X-Analysis, the splash screen and title bar read *WebSphere Studio Site Developer (Windows)*. When you start the WebSphere client independently (**Start** → **Programs** → **IBM WebSphere Studio** → **Development Studio Client for iSeries 5.1.2)**, the splash screen and title bar will read *WebSphere Development Studios Client for iSeries*. For the purpose of this chapter, the WebSphere client can be started by either method. For more information about the relationship between the WebSphere Studio Site Developer and the WebSphere Development Studios Client for iSeries, refer to *WebSphere Development Studio Client for iSeries Version 5.1.2*, SG24-6961.

7. The Generate Web Pages dialog box (Figure 3-58) appears with the message `Process completed`. Click **OK**.

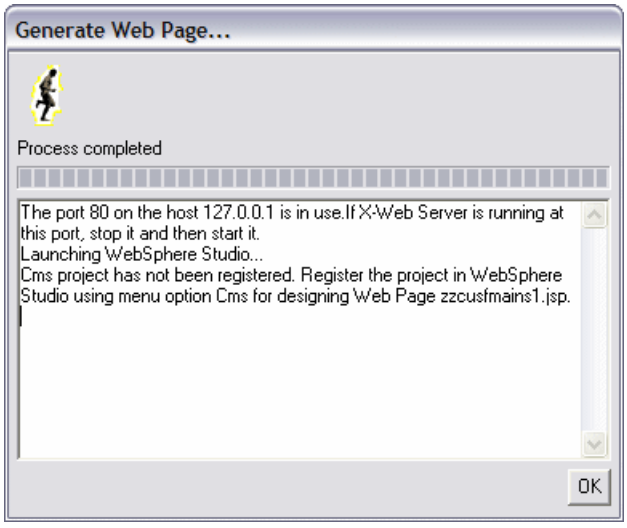
Generate Web Page...
Process completed
The port 80 on the host 127.0.0.1 is in use.If X-Web Server is running at this port, stop it and then start it.
Launching WebSphere Studio...
Cms project has not been registered. Register the project in WebSphere Studio using menu option Cms for designing Web Page zzcustmains1.jsp.
OK

Figure 3-59 Generate Web Pages process complete dialog box

8. Maximize the WebSphere Studio Site Developer from your task bar. The CMS project should appear on the menu bar. Click **Cms** and select **Register Project**.

> **Note:** The first time an X-Analysis re-engineering project is registered in WDSc, it may take some time for the Java abstract classes to be transferred to WDSc.

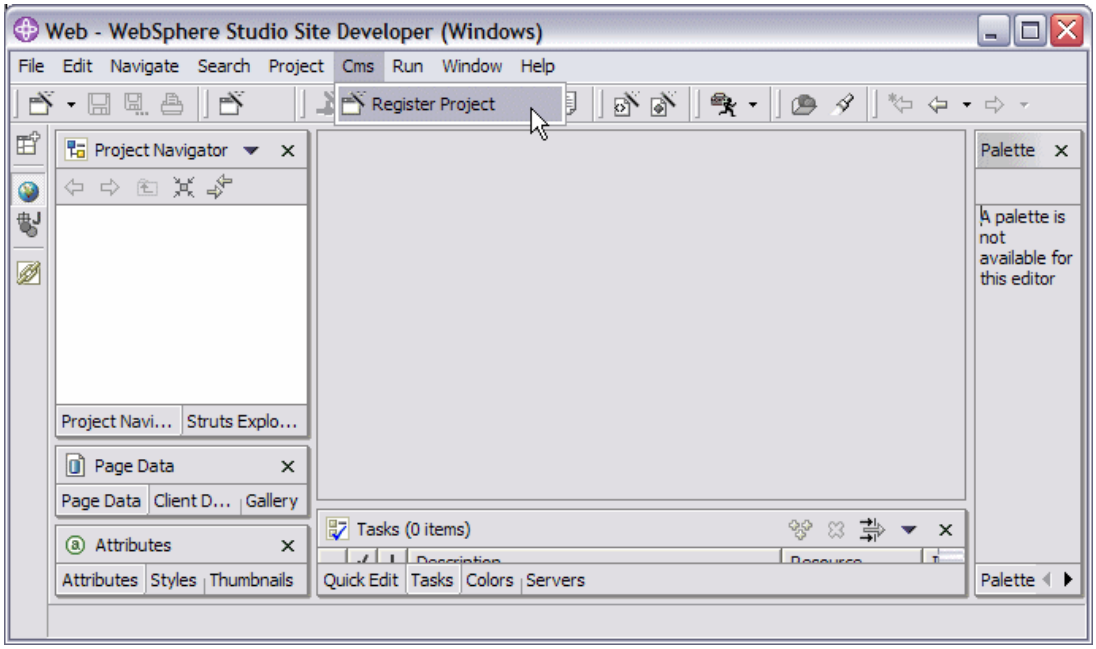

Figure 3-60 Registering the CMS project in WebSphere

> **Tip:** If the CMS column does not appear in the WebSphere menu bar, perform the following steps:
>
> 1. Select **Window** → **Custom Perspective**.
> 2. Expand the **Other** section in the Custom Perspective dialog box.
> 3. Select the **Register Project** check box.
> 4. Click **OK**.

9. The Register Project Plug In dialog box appears with message `Project cms registered`. Click **OK**.
10. The Cms project appears in the Project Navigator View.

> **Tip:** If the Cms project does not appear, verify that you are in the Web perspective. To change to the Web perspective, select **Window** → **Open Perspective** → **Web**.

3.13.3 Working with the Java components in WDSc

The Java components generated for the ZZCUSFMAINS1 re-engineered function definition can be reviewed and modified using WDSc. All of the Java components for the CMS application library are stored under the Cms project in WDSc.

1. If you do not already have WDSc running, select **Start** → **Programs** → **IBM WebSphere Studio** → **Development Studio Client for iSeries 5.1.2** to start WDSc on your PC.

Important: When you start WDSc, make sure that you use the correct workspace. X-Analysis stores the generated project in the WSSD folder under WDSc. In our example, the Java components are generated under the `C:\WDSC\WSSD\workspace` workspace. For more detailed information about using workspaces in WDSc, refer to *WebSphere Development Studio Client for iSeries Version 5.1.2*, SG24-6961.

2. Locate and expand the **Cms** project in the Project Navigator view.
3. Locate and expand the **Java Resources** folder under the Cms application.
4. The Java class packages appear in the Project Navigator view. These packages contain the Java abstract classes as well as specific classes created for the Cms project. You can expand any package and click on any class file to review the Java code.

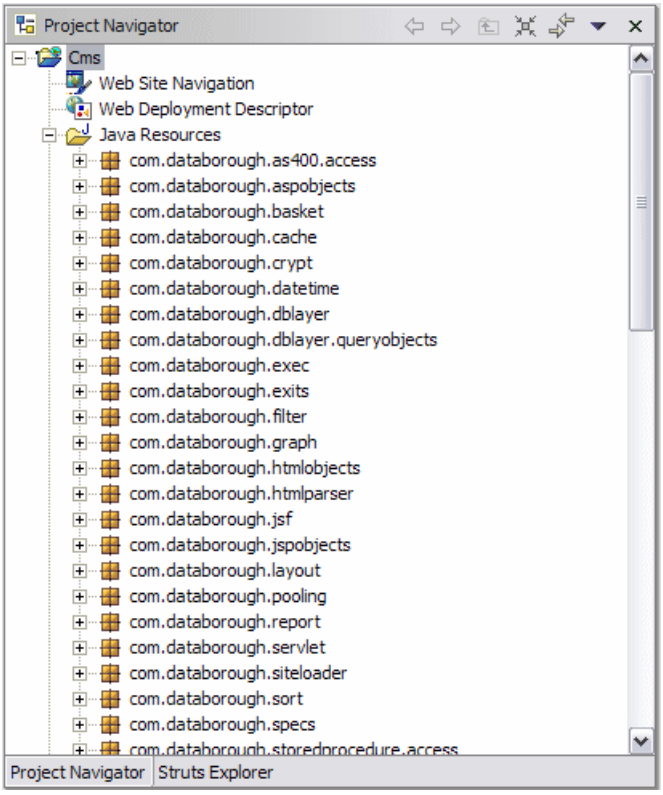

Figure 3-61 Java c/ass packages in WDSc

5. Scroll down in the Project Navigator view and expand the **jsf** folder. In this folder, you will see the JSFs for your application. Double-click **zzcusfmains1.jsp** to open it in the Edit view (Figure 3-62).

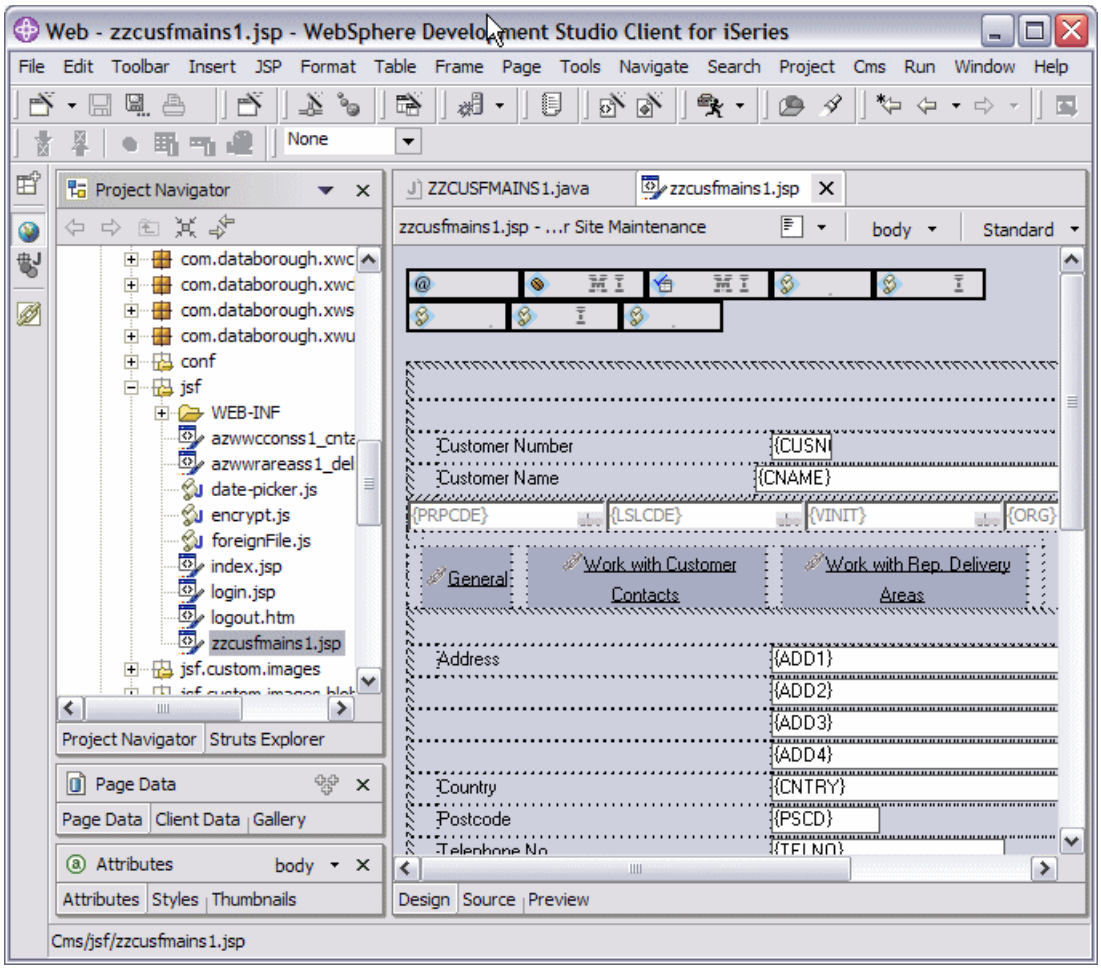

Figure 3-62 zzcusfmains1.jsp

6. The JSF is fully editable in the design mode. For the example project, we simply change the font attributes for the Customer number and name:
   a. To change the Customer Number font attributes, perform the following steps:
      i. Click the **CUSNO** text box.
      ii. Click the **Attributes** view.
      iii. Enter `background-color: transparent; font-size: 12pt; font-weight: bold` in the Properties field.
   b. To change the Customer Name font attributes, perform the following steps:
      i. Click the **CNAME** text box.
      ii. Click the **Attributes** view.
      iii. Enter `background-color: transparent; font-size: 12pt; font-weight: bold` in the Properties field.
      iv. Enter `30` in the Width field.
   c. Select **File** → **Save** to save the changes (Figure 3-63 on page 99).

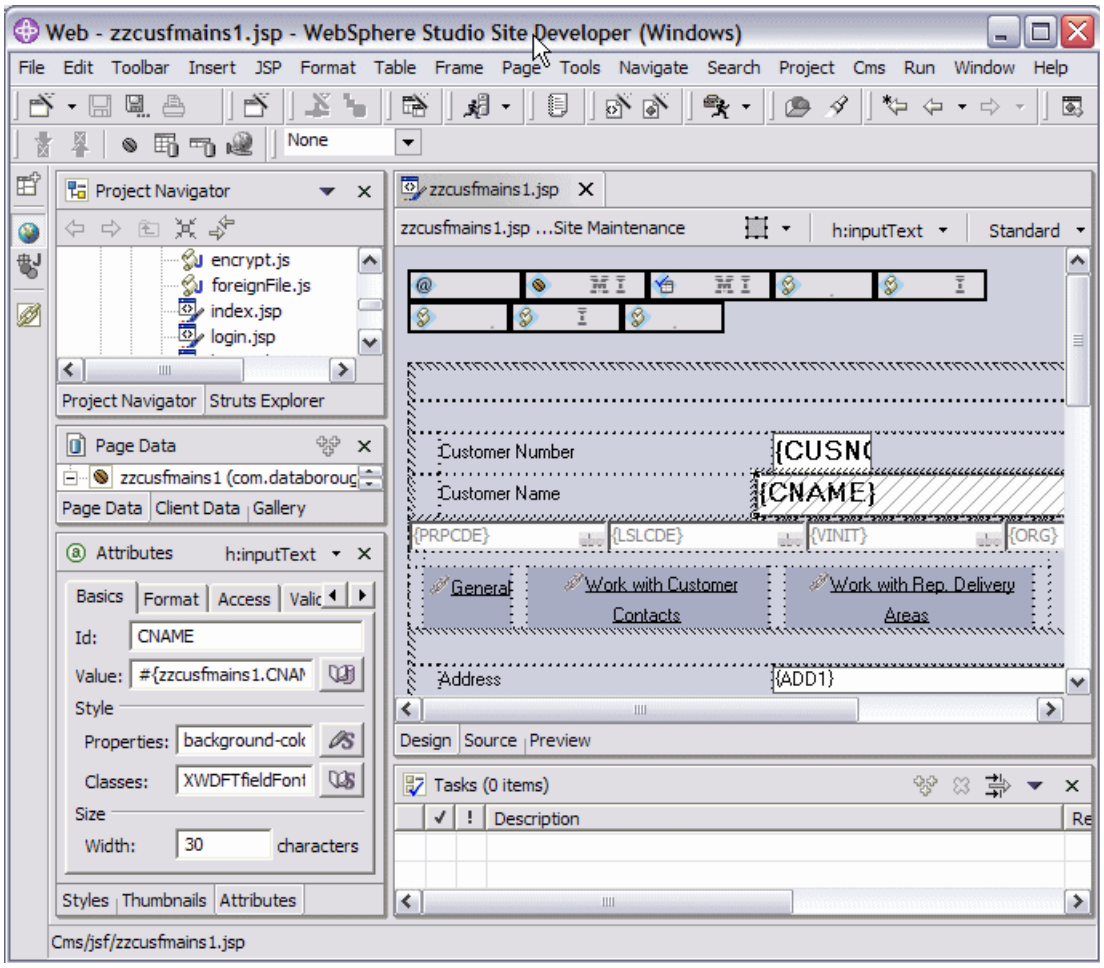

Figure 3-63 zzcusfmains1.jsp after changes

3.13.4 Viewing the application JSF

The JSF created for the ZZCUSFMAINS1 re-engineered function definition is now available for use by the X-Web server. To view the application:

1. Select **Start** → **Programs** → **X-Web** → **Start X-Web Server** to start the X-Web server on your PC.
2. Select **Start** → **Programs** → **X-Web** → **Test Sites** to launch the browser.
3. In the browser window (Figure 3-45 on page 83), enter your X-Web login information. This is the user ID and password you set up in your site definition. Click **Sign In**.
4. When you enter the application, the Customer Site Maintenance selection Web page (Figure 3-46 on page 84) appears. Click an individual record in the selection window to bring up the Customer Site Single Record Web page (Figure 3-64 on page 100).

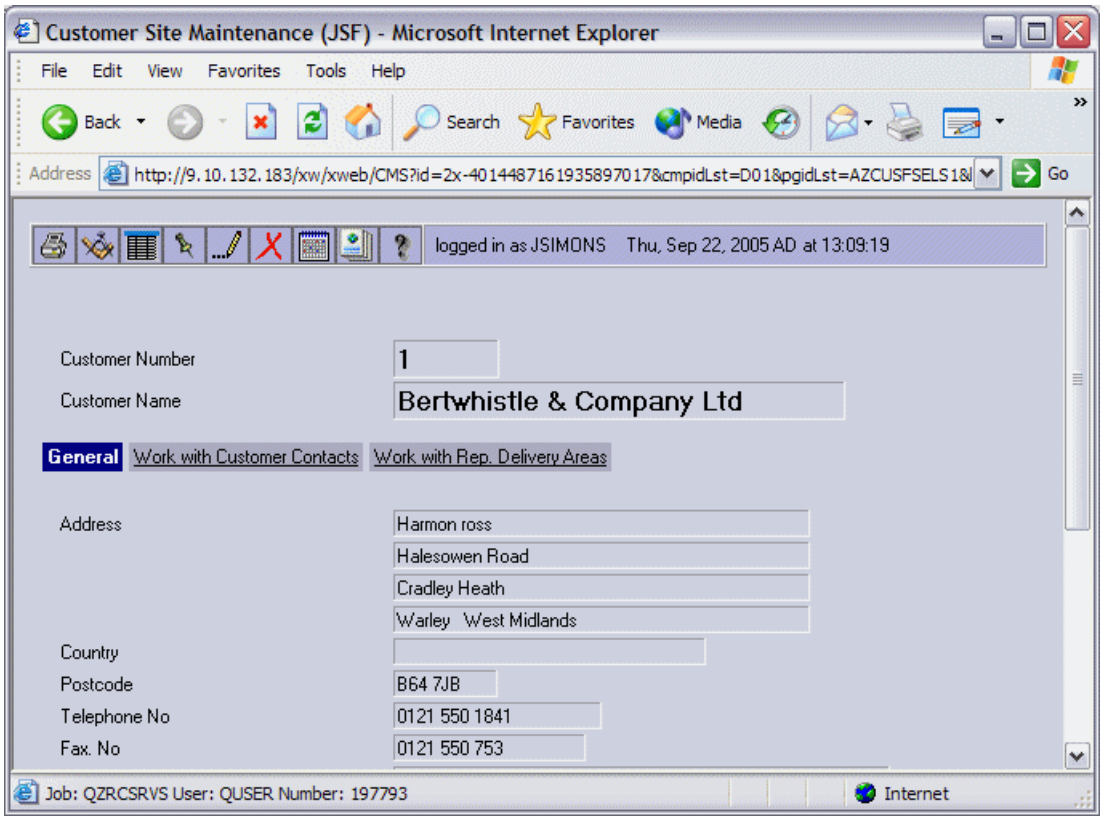
Customer Site Maintenance (JSF) - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://9.10.132.183/xw/xweb/CMS?id=2x-4014487161935897017&cmpidLst=D01&pgidLst=AZCUSFSELS1&
Go
logged in as JSIMONS Thu, Sep 22, 2005 AD at 13:09:19
Customer Number 1
Customer Name Bertwhistle & Company Ltd
General Work with Customer Contacts Work with Rep. Delivery Areas
Address Harmon ross
Halesowen Road
Cradley Heath
Warley West Midlands
Country
Postcode B64 7JB
Telephone No 0121 550 1841
Fax. No 0121 550 753
Job: QZRCSRVS User: QUSER Number: 197793
Internet

Figure 3-64 Customer Site Single Record Web page (JSF)

Tip: The browser title bar indicates whether the page being displayed was built from a function definition or a JSF. Web pages built from a JSF have the text `(JSF)` included after the function name in the title bar.

Once again, you can test the validation logic:

1. Click the Edit button on the toolbar.

2. Enter `BADVALUE` in the Telephone No. field and click **Update**. The JSF reflects the appropriate error message (Figure 3-65).

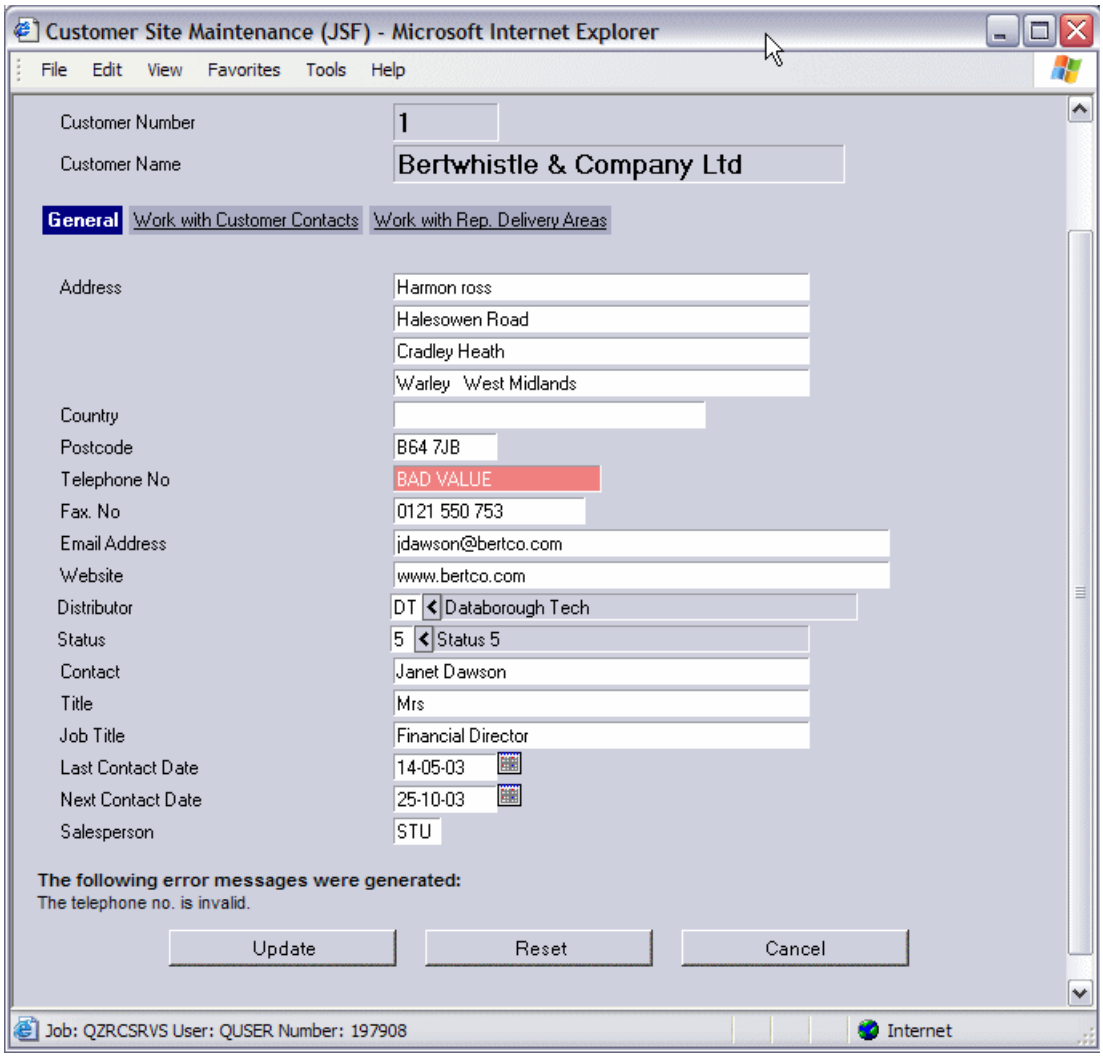

Figure 3-65 JSF validation example

3.13.5 How the JavaServer Faces application works

Quite a bit of code execution occurs behind the scenes to execute the simple telephone validation edit on the Customer Site Single Record Web page. Figure 3-66 outlines this process.

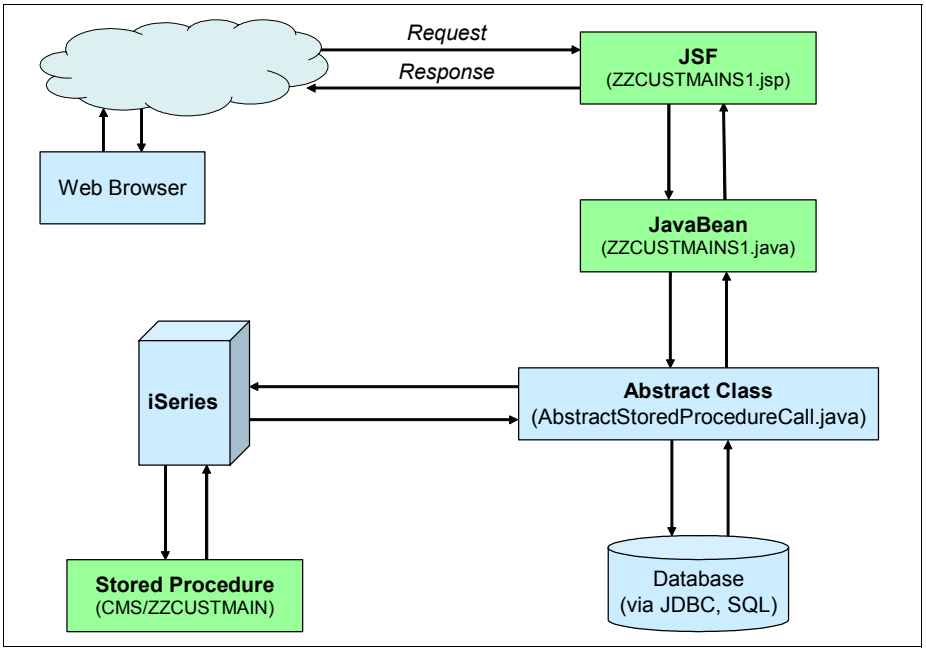

Figure 3-66 Process flow for JSF Web application

There are four primary components involved:

- zzcusfmains1.jsp (a JSF)
- ZZCUSFMAINS1.java (a JavaBean)
- AbstractStoredProcedureCall.java (a Java class)
- ZZCUSFMAIN (a stored procedure)

To review the source code for zzcusfmains1.jsp in WDSc, perform the following steps:

1. Expand the **jsf** folder in the Project Navigator (Figure 3-62 on page 98).
2. Under the expanded jsf folder, double-click **zzcusfmains1.jsp** and click the **Source** tab in the Edit View.

To review the source code for ZZCUSFMAINS1.java, in WDSc, perform the following steps:

1. Expand the **com.databorough.storedprocedure.access** package in the Project Navigator.
2. Under the expanded package, double-click **ZZCUSFMAINS1.java**.

To review the source code for AbstractStoredProcedureCall.java in WDSc:

1. Expand the **com.databorough.storedprocedure.access** package in the Project Navigator.
2. Under the expanded package, double-click **AbstractStoredProcedureCall.java**.

To review the source code for ZZCUSFMAIN in WDSc, do the following steps:

1. Switch to the Remote System Explorer perspective (**Window** → **Open Perspective** → **Remote System Explorer**).
2. Expand the **QRPGLESRC** file under the CMS library in the User Library folder for your iSeries. Under the QRPGLESRC file, double-click **ZZCUSFMAIN**.

Processing the update request

An update record request comes from the Customer Site Single Record Web page in the Web browser and is routed to the JSF that is used to display and accept input for that Web page.

The JSF module (zzcusfmains1.jsp) receives the update record request from the browser and responds by calling the update method of its associated JavaBean (ZZCUSTFMAINS1.java) (Example 3-1).

Example 3-1 Call update method of zzcusfmains1.java

```
jsp:useBean id="zzcusfmains1" class="com.databorough.storedprocedure.access.ZZCUSFMAINS1"
scope="session" />
....
....
   else if (request.getParameter("updRec.x") != null)

   {
      // Update the data
      zzcusfmains1.update();
   }
```

The class ZZCUSFMAINS1 in the JavaBean ZZCUSFMAINS1.java extends the AbstractStoredProcedureCall class (Example 3-2).

Example 3-2 Class ZZCUSFMAINS1.java

```
package com.databorough.storedprocedure.access;

/**
 * Insert the type's description here.
 * Creation date: (09/22/05 01:30:48 PM)
 * @author: Amit Arya
 */
import com.ibm.as400.access.AS400;

public class ZZCUSFMAINS1 extends AbstractStoredProcedureCall{
```

As the Java class ZZCUSFMAINS1 does not implement the update method, we look to its super class AbstractStoredProcedureCall for the implementation details.

The update method of the AbstractStoredProcedureCall invokes the call method to implement the stored procedure call (Example 3-3).

Example 3-3 Invoke stored procedure call

```
public abstract class AbstractStoredProcedureCall implements ActionListener{
...
...
/**
 * Updates the data.
 * @version: (6/25/2004 4:30:49 PM
 * @return boolean
```

```
 */
public boolean update()
{
   return call(spec.fun, spec.shadowProgramName, UPDATE, date, time);
}
```

Notice that the first two parameters passed specify the JSF name and the stored procedure (shadow program) name. These were set to constants in the prepareSpec() method of the ZZCUSFMAINS1 JavaBean (Example 3-4).

Example 3-4 prepareSpec() method

```
publicstatic final String fun = "ZZCUSFMAINS1";
publicstatic final String storedProc = "ZZCUSFMAIN";

...

protected void prepareSpec()
{
   spec.fun = fun;
   spec.shadowProgramName = storedProc;
```

The call method of the AbstractStoredProcedureCall class creates a validation request prior to the update. For the validation request, it formats the correct parameter lists and makes a Program Call Markup Language (PCML) to the stored procedure program ZZCUSFMAIN on the iSeries (Example 3-5).

Example 3-5 Call stored procedure

```
/**
 * Calls a stored procedure.
 *
 * @version: (6/6/04 5:31:14 PM)
 *
 * @return boolean
 *
 * @param fun java.lang.String
 * @param storedProc java.lang.String
 * @param entryPoint java.lang.String
 * @param date java.lang.String
 * @param time java.lang.String
 */
protected boolean call(String fun, String storedProc, String entryPoint, String date,
String time)
{
   // Reset action outcome
   messageTypes = null;
   messages = null;
   fieldsInMessages = null;
   messageType = " ";
   messageFields = null;
   actionOutcomeProcessed = false;
...
...
```

The PCML call starts a job on the iSeries in the QUSRWRK subsystem with job name QZRCSRVS. This job calls the stored procedure ZZCUSFMAIN in the CMS library. When the ZZCUSFMAIN stored procedure receives a validation request for the ZZCUSTFMAINS1 format, it executes the zvalids1 subroutine (Example 3-6 on page 105).

Example 3-6 Execute subroutine - zvalids1

```
C* VALIDATION
 C                   when      entrypoint = 'VALIDATION'
 C                   select
 C                   when      callingfun = 'ZZCUSFMAINS1'
 C                   exsr      zvalids1
```

The zvalids1 subroutine contains a business rule to validate that the telephone number consists of any combination of digits or blanks (Example 3-7).

Example 3-7 Validate telephone number

```
C* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/211 Validation.
C*  VOOOO2  CUSF        TELNO       The telephone no. is invalid.
C*  If the field "Phone" is not blank , verify the field "Phone" again
C*  0123456789'. If other values found then the field "Phone" is inval
C* Telephone number
C                   if        TELNO <> *blanks
C     ' 0123456789' check     TELNO         z1
C                   if        %found
C* Return message: "The telephone no. is invalid."
C                   eval      n1 = n1 + 1
C                   if        n1 <= 20
C                   eval      rtnflds(n1) = 'TELNO'
C                   eval      rtnmsgids(n1) = 'OEM0014'
C                   eval      rtnmsgtp  = 'E'
C                   endif
C                   endif
```

When the validation fails, the error message is sent back as part of the response. The AbstractStoredProcedureCall class aborts the update request and passes the message back to the JSF zzcusfmains1.jsp for display in the browser.

If the validation had been processed sucessfully, the AbstractStoredProcedureCall class would have constructed an SQL statement and executed it against the iSeries database to update the CUSF file.

Tip: The job invoked by the PCML call to the iSeries can be viewed from an iSeries command line using the WRKACTJOB command. The job name/user ID will always be QZRCSRVS/QUSER. The job number can be found in the status bar of the JSF Web page (see Figure 3-65 on page 101). The stored procedure can be debugged using the STRSRVJOB command or the iterative debugger found in WDSc.

Stored procedure ZZCUSFMAIN

Example 3-8 gives the full text for the ZZCUSFMAIN stored procedure.

Example 3-8 Stored procedure ZZCUSFMAIN

```
H*?-------------------------------------------------------------------
     H*?COPYRIGHT DATABOROUGH LTD 2005
     H*?
     H*?PROGRAM:  Shadow Program for ZZCUSFMAINS1
     H*?AUTHOR:   Databorough Ltd.
     H*?VERSION:  No:   1.00    Date: 23/09/2005  Time: 15:52:03
     H*?-------------------------------------------------------------------
     H debug(*yes)
     Fdists     if   e           k disk
```

```
     D*************************************************************************
     D*?D e f i n i t i o n s
     D*************************************************************************
     D*?*ENTRY parameters:-
     D*?Job values
     D inuser          s             10
     D indate          s              8
     D intime          s              6
     D*?Action required (ADD/UPDATE/DELETE/DISPLAY)
     D action          s             10
     D*?Entry point
     D entrypoint      s             20
     D*?21 X 3000 bytes of data representing a single record for each of the
     D*?primary physical file & upto 20 secondary files
     D indbf           s           3000    dim(21)
     D*?Return message type
     D rtnmsgtp        s              1
     D*?Array for return messages
     D rtnmsg          s             80    dim(20)
     D*?Array for return messages ids
     D rtnmsgids       s              7    dim(20)
     D*?Array for the fields to which messages relate
     D rtnflds         s             30    dim(20)
     D*?Flag to indicate if fields have been updated
     D rtnupdbuf       s              1
     D*?New function name for PREENTRY processing
     D rtnnewfun       s             20
     D*?Further fields
     D gtots           s             30p 9
     D zworkflds       s             50a   dim(20)
     D zwfnames        s             30a   dim(20)
     D zwftypes        s              1a   dim(20)
     D*?Supressed fields:
     D supflds         s             30    dim(20)
     D*?Fields to be displayed as constants:
     D conflds         s             30    dim(20)
     D*?Fields with overriden colors:
     D clrflds         s             30    dim(20)
     D*?Overriden colors:
     D ovrclrs         s              3    dim(20)

     D*?Calling function (passed in rtnnewfun field)
     D callingfun      s             20a

     D*?Work fields
     D n1              s              5p 0
     D z1              s              5p 0
     D statuses        s              1a   dim(37) ctdata perrcd(37)           CMD Key
Data

     D*?Format file data

     D*?FILE NAME
     d CUSF          e ds                  extname(CUSF)

     C*************************************************************************
     C*?M a i n l i n e   C o d e
     C*************************************************************************
     C*?Format file records
```

```
     C                   eval      CUSF       = indbf(001)

     C*?Process individual entry points etc
     C                   select

     C*?PREDISPLAY
     C                   when      entrypoint = 'PREDISPLAY'
     C                   exsr      zpredisp
     C*?VALIDATION
     C                   when      entrypoint = 'VALIDATION'
     C                   select
     C                   when      callingfun = 'ZZCUSFMAINS1'
     C                   exsr      zvalids1
     C                   endsl
     C*?PREUPDATE
     C                   when      entrypoint = 'PREUPDATE '
     C                   exsr      zpreupd
     C*?POSTUPDATE
     C                   when      entrypoint = 'POSTUPDATE'
     C                   exsr      zpostupd
     C*?PREENTRY
     C                   when      entrypoint = 'PREENTRY'
     C                   exsr      zpreentry
     C*?ONEXIT
     C                   when      entrypoint = 'ONEXIT'
     C                   exsr      zonexit
     C*?CALL TO EXIT PROGRAM
     C                   when      action = 'CALL'
     C                   exsr      zcallexp

     C                   endsl

     C*?Update buffers if necessary
     C                   if        rtnupdbuf = 'Y'
     C                   eval      indbf(001) = CUSF
     C                   endif

     C*?Perform Termination Routines
     C                   eval      *inlr = *on
     C                   return
     C*************************************************************************
     C*?L o g i c a l   E n d   o f   P r o g r a m
     C*************************************************************************

     C*************************************************************************
     C*?PREDISPLAY
     C*************************************************************************
     C     zpredisp      begsr
     C                   endsr
     C*************************************************************************

     C*************************************************************************
     C*?VALIDATION
     C*************************************************************************
     C     zvalids1      begsr
?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/202 Validation.
?@!BRC*  V00001  CUSF        CNAME       You must enter the customer name.
?=!BRC*  If the field "Company" is blank then it is invalid.
     C*?Customer name
     C                   if        CNAME = *blanks
```

```
     C* Return message: "You must enter the customer name."
     C                   eval      n1 = n1 + 1
     C                   if        n1 <= 20
     C                   eval      rtnflds(n1) = 'CNAME'
     C                   eval      rtnmsgids(n1) = 'OEM0012'
     C                   eval      rtnmsgtp  = 'E'
     C                   endif
     C                   endif
?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/211 Validation.
?@!BRC*  V00002  CUSF        TELNO       The telephone no. is invalid.
?=!BRC*  If the field "Phone" is not blank , verify the field "Phone" against '
?=!BRC*  0123456789'. If other values found then the field "Phone" is invalid.
     C*?Telephone number
     C                   if        TELNO <> *blanks
     C     ' 0123456789' check     TELNO         z1
     C                   if        %found
     C* Return message: "The telephone no. is invalid."
     C                   eval      n1 = n1 + 1
     C                   if        n1 <= 20
     C                   eval      rtnflds(n1) = 'TELNO'
     C                   eval      rtnmsgids(n1) = 'OEM0014'
     C                   eval      rtnmsgtp  = 'E'
     C                   endif
     C                   endif
     C                   endif
?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/223 Validation.
?@!BRC*  V00003  CUSF        FAXNO       The fax. no. is invalid.
?=!BRC*  If the field "Fax. No." is not blank , verify the field "Fax. No."
?=!BRC*  against ' 0123456789'. If other values found then the field "Fax. No."
?=!BRC*  is invalid.
     C*?Fax number
     C                   if        FAXNO <> *blanks
     C     ' 0123456789' check     FAXNO         z1
     C                   if        %found
     C* Return message: "The fax. no. is invalid."
     C                   eval      n1 = n1 + 1
     C                   if        n1 <= 20
     C                   eval      rtnflds(n1) = 'FAXNO'
     C                   eval      rtnmsgids(n1) = 'OEM0015'
     C                   eval      rtnmsgtp  = 'E'
     C                   endif
     C                   endif
     C                   endif
?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/235 Validation.
?@!BRC*  V00004  CUSF        DSDCDE      The distributor is invalid.
?=!BRC*  If the field "Distributor" is not blank , verify the field "Distributor"
?=!BRC*  against the file "Distributors". If not on file then the field
?=!BRC*  "Distributor" is invalid.
     C*?Distributor
     C                   if        DSDCDE <> *blanks
     C     DSDCDE        setll(e)  rprods
     C                   if        not %equal(dists)
     C* Return message: "The distributor is invalid."
     C                   eval      n1 = n1 + 1
     C                   if        n1 <= 20
     C                   eval      rtnflds(n1) = 'DSDCDE'
     C                   eval      rtnmsgids(n1) = 'OEM0018'
     C                   eval      rtnmsgtp  = 'E'
     C                   endif
     C                   endif
```

```
     C                   endif
?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/247 Validation.
?@!BRC*  V00005  CUSF        STATUS      The status is invalid.
?=!BRC*  If the field "Sts" is not blank , set the field Z1 to 1 , verify the
?=!BRC*  field "Sts" against the array STATUSES from Z1. If not found then the
?=!BRC*  field "Sts" is invalid.
     C*?Status
     C                   if        STATUS <> *blanks
     C                   eval      z1 = 1
     C     STATUS        lookup    statuses(z1)                            77
     C                   if        not %found
     C* Return message: "The status is invalid."
     C                   eval      n1 = n1 + 1
     C                   if        n1 <= 20
     C                   eval      rtnflds(n1) = 'STATUS'
     C                   eval      rtnmsgids(n1) = 'OEM0019'
     C                   eval      rtnmsgtp  = 'E'
     C                   endif
     C                   endif
     C                   endif
?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/260 Validation.
?@!BRC*  V00006  CUSF        USERNM      You must enter a contact name.
?=!BRC*  If the field "Contact" is blank then it is invalid.
     C*?Contact
     C                   if        USERNM = *blanks
     C* Return message: "You must enter a contact name."
     C                   eval      n1 = n1 + 1
     C                   if        n1 <= 20
     C                   eval      rtnflds(n1) = 'USERNM'
     C                   eval      rtnmsgids(n1) = 'OEM0020'
     C                   eval      rtnmsgtp  = 'E'
     C                   endif
     C                   endif
?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/269 Validation.
?@!BRC*  V00007  CUSF        SALUT       The title is invalid.
?=!BRC*  If the field "Salutation" is not blank. If the field "Salutation" is not
?=!BRC*  'Mr' and the field "Salutation" is not 'Mrs' and the field "Salutation"
?=!BRC*  is not 'Ms' and the field "Salutation" is not 'Dr' and the field
?=!BRC*  "Salutation" is not 'Doctor' and the field "Salutation" is not
?=!BRC*  'Professor' and the field "Salutation" is not 'Sir' and the field
?=!BRC*  "Salutation" is not 'Lord' and the field "Salutation" is not 'Lady' then
?=!BRC*  the field "Salutation" is invalid.
     C*?Title
     C                   if        SALUT <> *blanks
     C                   if        SALUT <> 'Mr'
     C                              and SALUT <> 'Mrs'
     C                              and SALUT <> 'Ms'
     C                              and SALUT <> 'Dr'
     C                              and SALUT <> 'Doctor'
     C                              and SALUT <> 'Professor'
     C                              and SALUT <> 'Sir'
     C                              and SALUT <> 'Lord'
     C                              and SALUT <> 'Lady'
     C* Return message: "The title is invalid."
     C                   eval      n1 = n1 + 1
     C                   if        n1 <= 20
     C                   eval      rtnflds(n1) = 'SALUT'
     C                   eval      rtnmsgids(n1) = 'OEM0021'
     C                   eval      rtnmsgtp  = 'E'
     C                   endif
```

```
C                   endif
C                   endif
C                   endsr
C*****************************************************************

C*****************************************************************
C*?PREUPDATE
C*****************************************************************
C     zpreupd       begsr
C                   endsr
C*****************************************************************

C*****************************************************************
C*?POSTUPDATE
C*****************************************************************
C     zpostupd      begsr
C                   endsr
C*****************************************************************

C*****************************************************************
C*?PREENTRY
C*****************************************************************
C     zpreentry     begsr
C                   endsr
C*****************************************************************

C*****************************************************************
C*?ONEXIT
C*****************************************************************
C     zonexit       begsr
C                   endsr
C*****************************************************************

C*****************************************************************
C*?EXIT PROGRAM
C*****************************************************************
C     zcallexp      begsr
C                   endsr
C*****************************************************************

C*****************************************************************
C*?Initialisation
C*****************************************************************
C     *inzsr        begsr

C                   eval      callingfun = rtnnewfun
C                   eval      rtnnewfun = *blanks

C                   endsr
C*****************************************************************

C*****************************************************************
C*?N o n - e x e c u t a b l e   C o d e
C*****************************************************************
C     *entry        plist
C                   parm                    inuser
C                   parm                    indate
C                   parm                    intime
C                   parm                    action
C                   parm                    entrypoint
```

```
     C                   parm                    indbf
     C                   parm                    rtnmsgtp
     C                   parm                    rtnmsg
     C                   parm                    rtnmsgids
     C                   parm                    rtnflds
     C                   parm                    rtnupdbuf
     C                   parm                    rtnnewfun
     C                   parm                    gtots
     C                   parm                    zworkflds
     C                   parm                    zwfnames
     C                   parm                    zwftypes
     C                   parm                    supflds
     C                   parm                    confldS
     C                   parm                    clrflds
     C                   parm                    ovrclrs
     C*****************************************************************
**
 0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ
```

4

Application maintainability and re-engineering

Powerful application maintainability and re-engineering features are available within X-Analysis. This chapter examines those features and provides some scenarios for using them, including step-by-step examples.

These features are discussed:

- Integrated maintenance environment
- Application analysis and documentation
- Program analysis and understanding
- Using X-Analysis cross-reference repository for modernizing
- Performing field re-engineering

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4.1 Introducing the X-Analysis cross-reference repository

The foundation of X-Analysis is the X-Analysis cross-reference repository. During the application initialization step, X-Analysis builds a cross-reference repository of every line of source code in the existing application. This repository is then completely cross-indexed and analyzed, enabling any cross-reference query to run instantly. The user can then produce data flow diagrams or structure charts on demand at the application level or the individual program level. The program code can also be represented in either overview or complete form as flowcharts, pseudo code, or internal structure charts.

The X-Analysis diagrams are entirely interactive in that selection is allowed on any diagram object. This enables new actions to be initiated focused on the selected object.

The cross-reference repository can also be accessed programmatically, allowing the source code to be automatically updated for re-engineering operations. Project sizing estimates could be produced by programmatically querying the repository. A good example of such an operation is provided by the X-Analysis field resizing facility. (See 4.6, “Performing field re-engineering” on page 159.) At any point, a group of objects (or a complete application area) can be fully documented by exporting the required program and application diagrams to Microsoft Word or Visio.

4.2 Integrated maintenance environment

X-Analysis provides a complete set of navigation and documentation facilities for viewing existing applications. Every detail of the application source code is comprehensively cross-indexed, so the Where Used features can be used both for impact analysis and to facilitate program understanding. X-Analysis is used to gain a better understanding of areas of the application unfamiliar to the analyst or developer. The documentation and cross-reference features are then used to map out code changes prior to implementing the edits in the Live Parsing Editor (LPEX) or Source Entry Utility (SEU).

4.2.1 Variable Where Used

The underlying function of X-Analysis that performs the impact analysis is called Variable Where Used (VWU). VWU lists all of the source lines where the field or variable of a file or program has been used or referenced in the Member source and its associated device files and copybooks throughout the application.

During impact analysis, a wide variety of object types and their constructs are interrogated by VWU. This list includes:

- Files (physical files, logical files, display files) and their data fields
- Programs/modules:
  - Array definitions
  - Data Structures
  - Data-Structures sub-fields
  - Indicators
  - Key Lists
  - Data Fields
  - File Formats
  - Subroutines
  - Program Variables
  - Array Elements
  - Parameter Lists

- Parameters
- Key Fields
- EXCPT Names

The X-Analysis Variable Where Used menu allows seven levels of VWU viewing. The list below describes the process that each of the View Levels uses to determine whether the source member statement contains a reference to the specified VWU field or variable. As the View Level is increased, references with greater indirection levels are displayed.

- View Level 1:
  - Finds all statements with direct references to the VWU field.
  - Displays/returns all statements found with direct references.
- View Level 2:
  - Finds all work fields that are directly referenced by the VWU field.
  - Displays and returns all statements included in Level 1 and any statements that contain the work fields found at Level 2.
- View Level 3:
  - Finds all work fields that are directly referenced by the work fields found in Level 2.
  - Displays and returns all statements included in Level 2 and any statements that contain the work fields found in this level.
- View Level 4 (Parameters):
  - Finds all work fields that are directly referenced by the work variables found in Level 3.
  - Finds all fields in called or calling programs that reference program parameters already identified in the process so far.
  - Finds all work fields that are directly referenced by the previously identified fields.
  - Displays and returns all statements included in Level 3 and any statements that contain the work fields and parameters found in this level.
- View Level 5 (Cascading Parameters):
  - Finds all work fields that are directly referenced by the work variables found in Level 4.
  - Finds all fields in the cascading set of called or calling programs that reference program parameters already identified in the process so far.
  - Displays and returns all statements included in Level 4 and any statements that contain the work fields and parameters found in this level.
- View Level 6 (Aliases):
  - Finds all work fields that are directly referenced by the work variables found in Level 5.
  - Finds all references to aliases of any of the database fields identified so far. An alias is defined as a field having a foreign key relationship to the field we are tracking.
- View Level 7 (Maximum Tracking):
  - Finds all work fields that are directly referenced by the work variables found in Level 6.
  - Apart from this, there is currently no difference between Level 6 and Level 7.

In the following example, we examine the impact of changing the field CUSNO in file CUSTS. To perform this analysis, follow these steps:

1. Select **Start** → **Programs** → **X-Analysis** → **XAnalysis (Online)** to start the X-Analysis client on your PC.

2. Locate the CMS application in the Application Libraries list on the left side of the X-Analysis window. Expand the CMS application and double-click **Source Files**.
3. A list of all source files in the library appears in the right pane of the window (Figure 4-1). Double-click **QDDSSRC** in the right pane of the window.

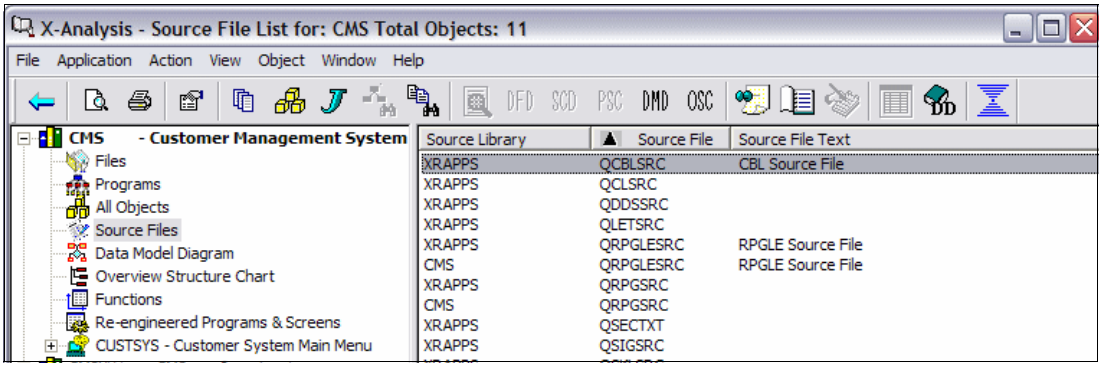

Figure 4-1 Source files List

4. All of the source file members in source file CMS/QDDSSRC appear in the right pane (Figure 4-2). Double-click the source file member named **CUSTS**.

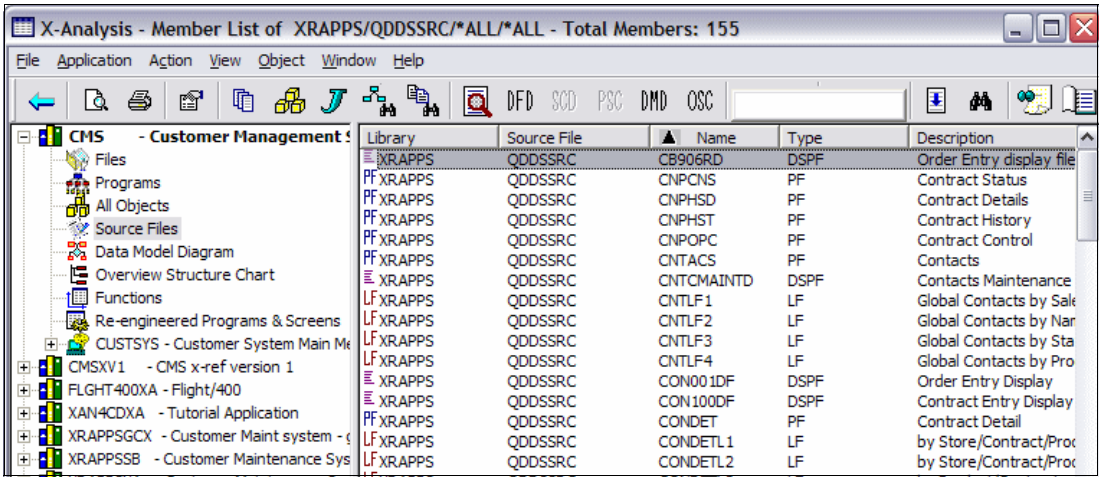
X-Analysis - Member List of XRAPPS/QDDSSRC/*ALL/*ALL - Total Members: 155
File Application Action View Object Window Help
CMS - Customer Management
Files
Programs
All Objects
Source Files
Data Model Diagram
Overview Structure Chart
Functions
Re-engineered Programs & Screens
CUSTSYS - Customer System Main Me
CMSXV1 - CMS x-ref version 1
FLGHT400XA - Flight/400
XAN4CDXA - Tutorial Application
XRAPPSGCX - Customer Maint system -
XRAPPSSB - Customer Maintenance Sys
Library Source File Name Type Description
XRAPPS QDDSSRC CB906RD DSPF Order Entry display file
XRAPPS QDDSSRC CNPCNS PF Contract Status
XRAPPS QDDSSRC CNPHSD PF Contract Details
XRAPPS QDDSSRC CNPHST PF Contract History
XRAPPS QDDSSRC CNPOPC PF Contract Control
XRAPPS QDDSSRC CNTACS PF Contacts
XRAPPS QDDSSRC CNTCMAINTD DSPF Contacts Maintenance
XRAPPS QDDSSRC CNTLF1 LF Global Contacts by Sale
XRAPPS QDDSSRC CNTLF2 LF Global Contacts by Nar
XRAPPS QDDSSRC CNTLF3 LF Global Contacts by Sta
XRAPPS QDDSSRC CNTLF4 LF Global Contacts by Pro
XRAPPS QDDSSRC CON001DF DSPF Order Entry Display
XRAPPS QDDSSRC CON100DF DSPF Contract Entry Display
XRAPPS QDDSSRC CONDET PF Contract Detail
XRAPPS QDDSSRC CONDETL1 LF by Store/Contract/Proc
XRAPPS QDDSSRC CONDETL2 LF by Store/Contract/Proc

Figure 4-2 Member List of the CMS/QDDSSRC

The source list for CUSTS appears (Figure 4-3).

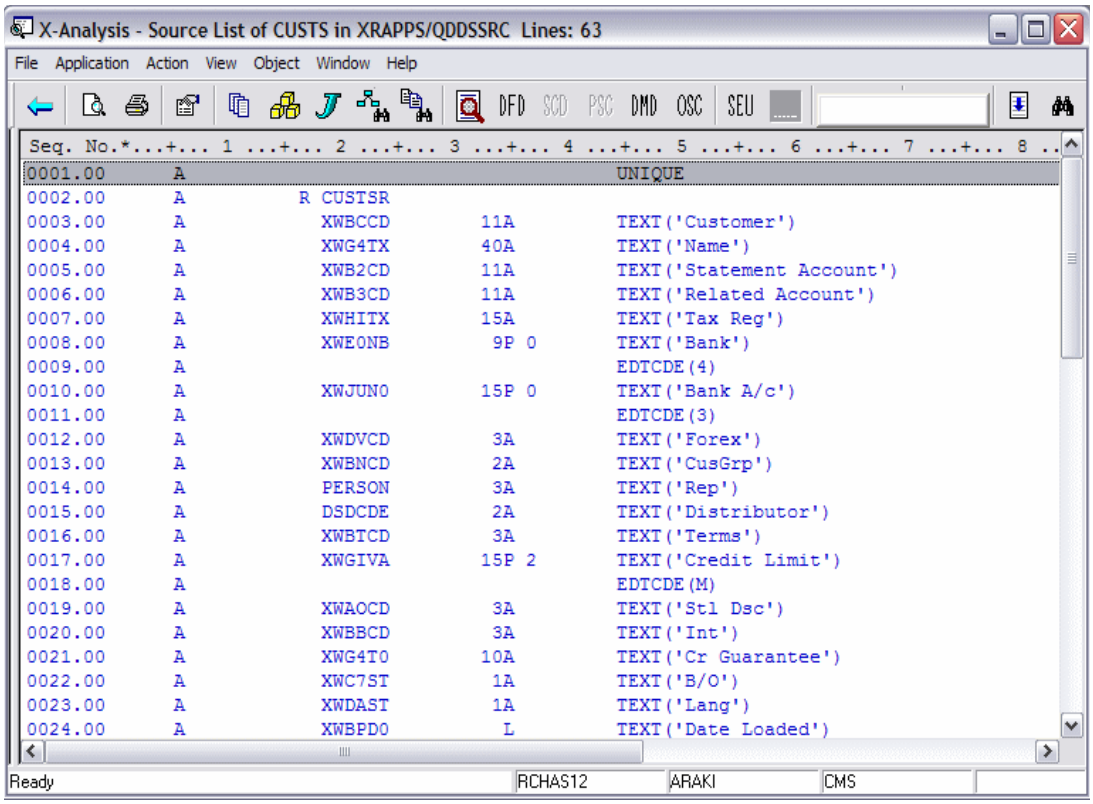
X-Analysis - Source List of CUSTS in XRAPPS/QDDSSRC Lines: 63
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
Seq. No.*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+... 8 ..
0001.00 A UNIQUE
0002.00 A R CUSTSR
0003.00 A XWBCCD 11A TEXT('Customer')
0004.00 A XWG4TX 40A TEXT('Name')
0005.00 A XWB2CD 11A TEXT('Statement Account')
0006.00 A XWB3CD 11A TEXT('Related Account')
0007.00 A XWHITX 15A TEXT('Tax Reg')
0008.00 A XWE0NB 9P 0 TEXT('Bank')
0009.00 A EDTCDE(4)
0010.00 A XWJUN0 15P 0 TEXT('Bank A/c')
0011.00 A EDTCDE(3)
0012.00 A XWDVCD 3A TEXT('Forex')
0013.00 A XWBNCD 2A TEXT('CusGrp')
0014.00 A PERSON 3A TEXT('Rep')
0015.00 A DSDCDE 2A TEXT('Distributor')
0016.00 A XWBTCD 3A TEXT('Terms')
0017.00 A XWGIVA 15P 2 TEXT('Credit Limit')
0018.00 A EDTCDE(M)
0019.00 A XWAOCD 3A TEXT('Stl Dsc')
0020.00 A XWBBCD 3A TEXT('Int')
0021.00 A XWG4T0 10A TEXT('Cr Guarantee')
0022.00 A XWC7ST 1A TEXT('B/O')
0023.00 A XWDAST 1A TEXT('Lang')
0024.00 A XWBPD0 L TEXT('Date Loaded')
Ready RCHAS12 ARAKI CMS

Figure 4-3 Source List of CUSTS

5. To search for the field CUSNO, enter `CUSNO` in the toolbar search text box and click the Search Text button. The line with the field CUSNO is highlighted (Figure 4-4).
6. Double-click the **CUSNO** field.

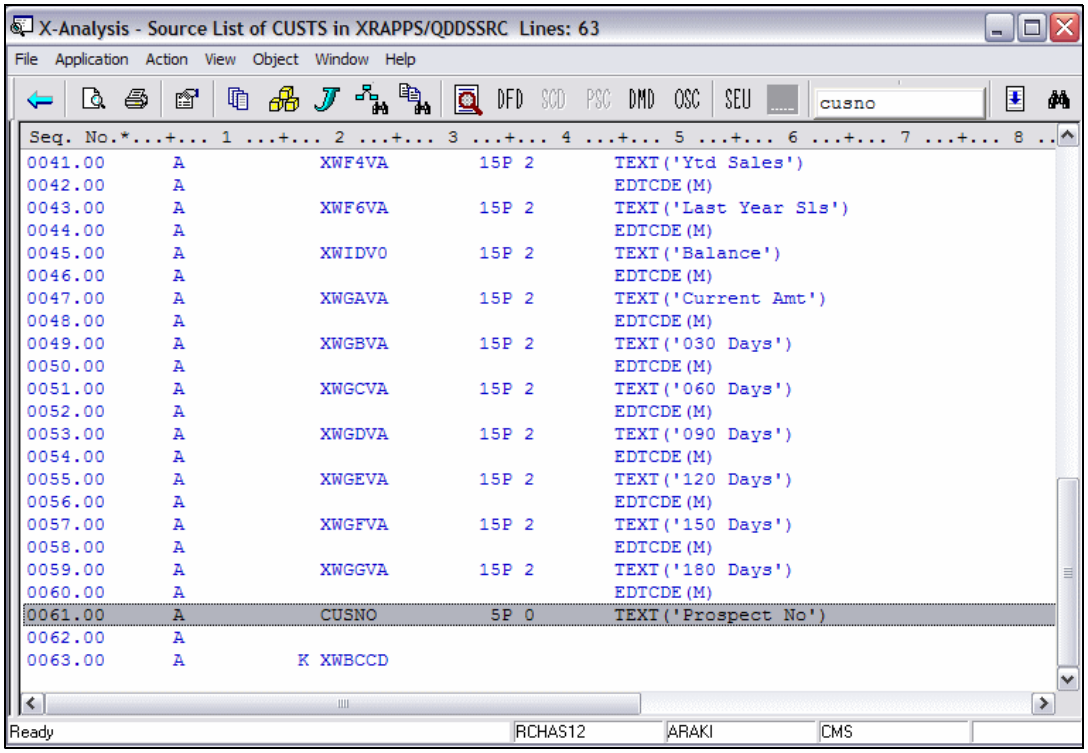
X-Analysis - Source List of CUSTS in XRAPPS/QDDSSRC Lines: 63
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
cusno
Seq. No.*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+... 8 ..
0041.00 A XWF4VA 15P 2 TEXT('Ytd Sales')
0042.00 A EDTCDE(M)
0043.00 A XWF6VA 15P 2 TEXT('Last Year Sls')
0044.00 A EDTCDE(M)
0045.00 A XWIDV0 15P 2 TEXT('Balance')
0046.00 A EDTCDE(M)
0047.00 A XWGAVA 15P 2 TEXT('Current Amt')
0048.00 A EDTCDE(M)
0049.00 A XWGBVA 15P 2 TEXT('030 Days')
0050.00 A EDTCDE(M)
0051.00 A XWGCVA 15P 2 TEXT('060 Days')
0052.00 A EDTCDE(M)
0053.00 A XWGDVA 15P 2 TEXT('090 Days')
0054.00 A EDTCDE(M)
0055.00 A XWGEVA 15P 2 TEXT('120 Days')
0056.00 A EDTCDE(M)
0057.00 A XWGFVA 15P 2 TEXT('150 Days')
0058.00 A EDTCDE(M)
0059.00 A XWGGVA 15P 2 TEXT('180 Days')
0060.00 A EDTCDE(M)
0061.00 A CUSNO 5P 0 TEXT('Prospect No')
0062.00 A
0063.00 A K XWBCCD
Ready
RCHAS12
ARAKI
CMS

Figure 4-4 Source List of CUSTS (field CUSNO is highlighted)

The Variable Where Used window for CUSTS/CUSNO - Level 1 appears (Figure 4-5).

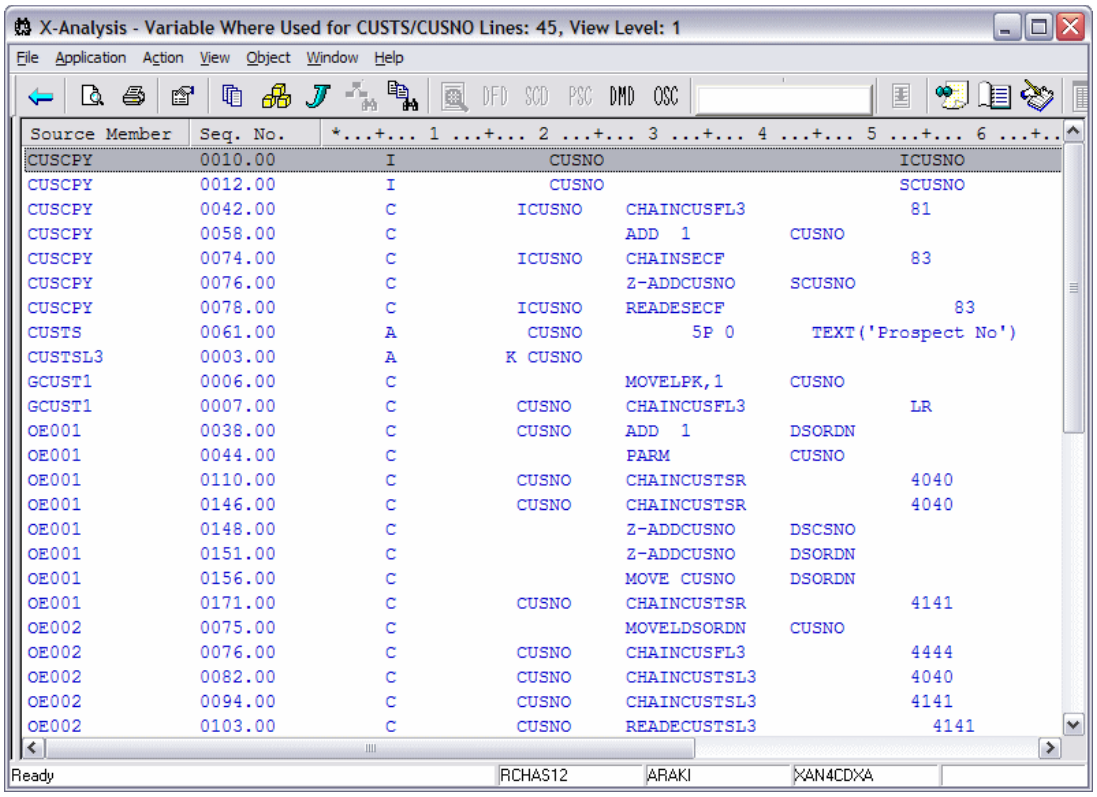
X-Analysis - Variable Where Used for CUSTS/CUSNO Lines: 45, View Level: 1
File Application Action View Object Window Help
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+..
CUSCPY 0010.00 I CUSNO ICUSNO
CUSCPY 0012.00 I CUSNO SCUSNO
CUSCPY 0042.00 C ICUSNO CHAINCUSFL3 81
CUSCPY 0058.00 C ADD 1 CUSNO
CUSCPY 0074.00 C ICUSNO CHAINSECF 83
CUSCPY 0076.00 C Z-ADDCUSNO SCUSNO
CUSCPY 0078.00 C ICUSNO READESECF 83
CUSTS 0061.00 A CUSNO 5P 0 TEXT('Prospect No')
CUSTSL3 0003.00 A K CUSNO
GCUST1 0006.00 C MOVELPK,1 CUSNO
GCUST1 0007.00 C CUSNO CHAINCUSFL3 LR
OE001 0038.00 C CUSNO ADD 1 DSORDN
OE001 0044.00 C PARM CUSNO
OE001 0110.00 C CUSNO CHAINCUSTSR 4040
OE001 0146.00 C CUSNO CHAINCUSTSR 4040
OE001 0148.00 C Z-ADDCUSNO DSCSNO
OE001 0151.00 C Z-ADDCUSNO DSORDN
OE001 0156.00 C MOVE CUSNO DSORDN
OE001 0171.00 C CUSNO CHAINCUSTSR 4141
OE002 0075.00 C MOVELDSORDN CUSNO
OE002 0076.00 C CUSNO CHAINCUSFL3 4444
OE002 0082.00 C CUSNO CHAINCUSTSL3 4040
OE002 0094.00 C CUSNO CHAINCUSTSL3 4141
OE002 0103.00 C CUSNO READECUSTSL3 4141
Ready RCHAS12 ARAKI XAN4CDXA

Figure 4-5 Variable Where Used for CUSTS/CUSNO - Level 1

7. To view Level 2, from the toolbar menu select **View** → **VWU Level** → **Level 2**. Variable Where Used for CUSTS/CUSNO - Level 2 appears (Figure 4-6).

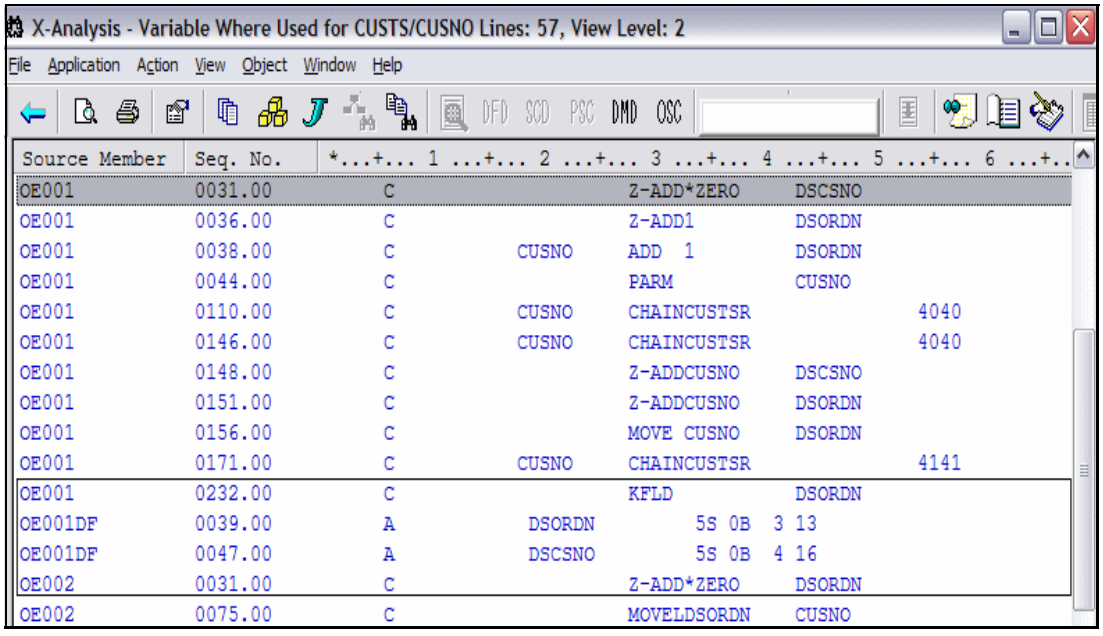
X-Analysis - Variable Where Used for CUSTS/CUSNO Lines: 57, View Level: 2
File Application Action View Object Window Help
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+..
OE001 0031.00 C Z-ADD*ZERO DSCSNO
OE001 0036.00 C Z-ADD1 DSORDN
OE001 0038.00 C CUSNO ADD 1 DSORDN
OE001 0044.00 C PARM CUSNO
OE001 0110.00 C CUSNO CHAINCUSTSR 4040
OE001 0146.00 C CUSNO CHAINCUSTSR 4040
OE001 0148.00 C Z-ADDCUSNO DSCSNO
OE001 0151.00 C Z-ADDCUSNO DSORDN
OE001 0156.00 C MOVE CUSNO DSORDN
OE001 0171.00 C CUSNO CHAINCUSTSR 4141
OE001 0232.00 C KFLD DSORDN
OE001DF 0039.00 A DSORDN 5S 0B 3 13
OE001DF 0047.00 A DSCSNO 5S 0B 4 16
OE002 0031.00 C Z-ADD*ZERO DSORDN
OE002 0075.00 C MOVELDSORDN CUSNO

Figure 4-6 Variable Where Used for CUSTS/CUSNO - Level 2

8. To view Level 3, from the toolbar menu select **View** → **VWU Level** → **Level 3**. Variable Where Used for CUSTS/CUSNO - Level 3 appears (Figure 4-7).

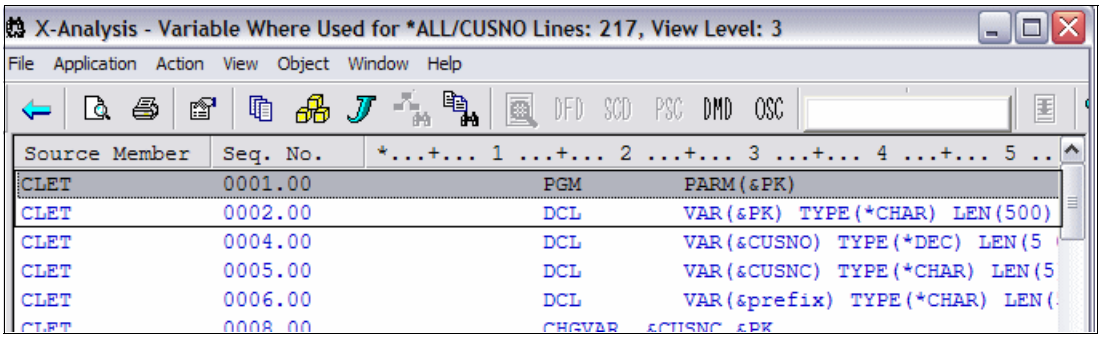
X-Analysis - Variable Where Used for *ALL/CUSNO Lines: 217, View Level: 3
File Application Action View Object Window Help
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ..
CLET 0001.00 PGM PARM(&PK)
CLET 0002.00 DCL VAR(&PK) TYPE(*CHAR) LEN(500)
CLET 0004.00 DCL VAR(&CUSNO) TYPE(*DEC) LEN(5
CLET 0005.00 DCL VAR(&CUSNC) TYPE(*CHAR) LEN(5
CLET 0006.00 DCL VAR(&prefix) TYPE(*CHAR) LEN(

Figure 4-7 Variable Where Used for CUSTS/CUSNO - Level 3

9. To view Level 4, from the toolbar menu select **View** → **VWU Level** → **Level 4**. Variable Where Used for CUSTS/CUSNO - View Level 4 appears (Figure 4-8). View Level 4 displays the lines where CUSNO is passed as a parameter.

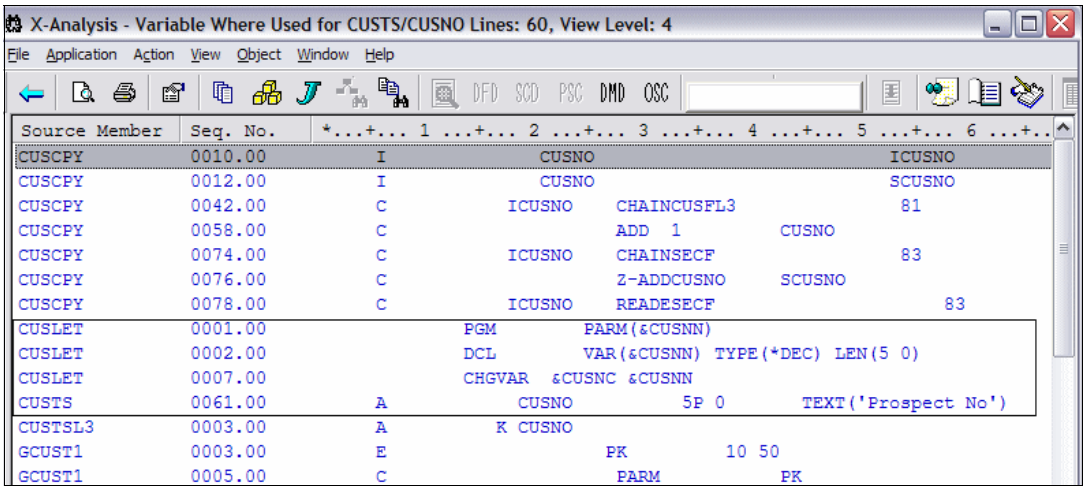
X-Analysis - Variable Where Used for CUSTS/CUSNO Lines: 60, View Level: 4
File Application Action View Object Window Help
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+..
CUSCPY 0010.00 I CUSNO ICUSNO
CUSCPY 0012.00 I CUSNO SCUSNO
CUSCPY 0042.00 C ICUSNO CHAINCUSFL3 81
CUSCPY 0058.00 C ADD 1 CUSNO
CUSCPY 0074.00 C ICUSNO CHAINSECF 83
CUSCPY 0076.00 C Z-ADDCUSNO SCUSNO
CUSCPY 0078.00 C ICUSNO READESECF 83
CUSLET 0001.00 PGM PARM(&CUSNN)
CUSLET 0002.00 DCL VAR(&CUSNN) TYPE(*DEC) LEN(5 0)
CUSLET 0007.00 CHGVAR &CUSNC &CUSNN
CUSTS 0061.00 A CUSNO 5P 0 TEXT('Prospect No')
CUSTSL3 0003.00 A K CUSNO
GCUST1 0003.00 E PK 10 50
GCUST1 0005.00 C PARM PK

Figure 4-8 Variable Where Used for CUSTS/CUSNO - Level 4

10. To view Level 5, from the toolbar menu select **View** → **VWU Level** → **Level 5**. Variable Where Used for CUSTS/CUSNO - View Level 5 appears (Figure 4-9). View Level 5 displays the cascading parameters as well.

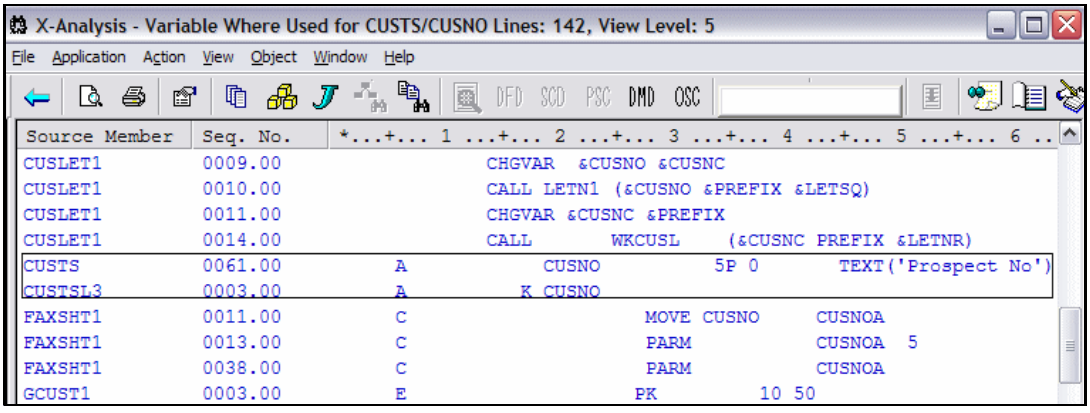
X-Analysis - Variable Where Used for CUSTS/CUSNO Lines: 142, View Level: 5
File Application Action View Object Window Help
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ..
CUSLET1 0009.00 CHGVAR &CUSNO &CUSNC
CUSLET1 0010.00 CALL LETN1 (&CUSNO &PREFIX &LETSQ)
CUSLET1 0011.00 CHGVAR &CUSNC &PREFIX
CUSLET1 0014.00 CALL WKCUSL (&CUSNC PREFIX &LETNR)
CUSTS 0061.00 A CUSNO 5P 0 TEXT('Prospect No')
CUSTSL3 0003.00 A K CUSNO
FAXSHT1 0011.00 C MOVE CUSNO CUSNOA
FAXSHT1 0013.00 C PARM CUSNOA 5
FAXSHT1 0038.00 C PARM CUSNOA
GCUST1 0003.00 E PK 10 50

Figure 4-9 Variable Where Used for CUSTS/CUSNO - Level 5

11. To view Level 6, from the toolbar menu select **View** → **VWU Level** → **Level 6**. Variable Where Used for CUSTS/CUSNO - View Level 6 appears (Figure 4-10). View Level 6 includes the lines where CUSNO is used as an alias.

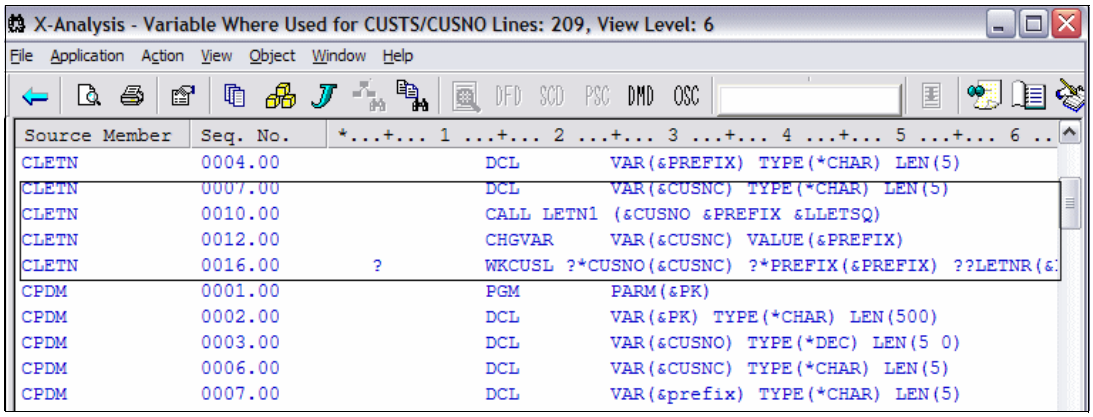
X-Analysis - Variable Where Used for CUSTS/CUSNO Lines: 209, View Level: 6
File Application Action View Object Window Help
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ..
CLETN 0004.00 DCL VAR(&PREFIX) TYPE(*CHAR) LEN(5)
CLETN 0007.00 DCL VAR(&CUSNC) TYPE(*CHAR) LEN(5)
CLETN 0010.00 CALL LETN1 (&CUSNO &PREFIX &LLETSQ)
CLETN 0012.00 CHGVAR VAR(&CUSNC) VALUE(&PREFIX)
CLETN 0016.00 ? WKCUSL ?*CUSNO(&CUSNC) ?*PREFIX(&PREFIX) ??LETNR(&
CPDM 0001.00 PGM PARM(&PK)
CPDM 0002.00 DCL VAR(&PK) TYPE(*CHAR) LEN(500)
CPDM 0003.00 DCL VAR(&CUSNO) TYPE(*DEC) LEN(5 0)
CPDM 0006.00 DCL VAR(&CUSNC) TYPE(*CHAR) LEN(5)
CPDM 0007.00 DCL VAR(&prefix) TYPE(*CHAR) LEN(5)

Figure 4-10 Variable Where Used for CUSTS/CUSNO - Level 6

12. To view Level 7, from the toolbar menu select **View** → **VWU Level** → **Level 7**. Variable Where Used for CUSTS/CUSNO - Level 7 appears (Figure 4-11). This is the maximum tracking level.

    As you can see, increasing the level provides more levels of reference indirection. At View Level 7, you see many references (both direct and indirect) to the CUSNO field. It should now be clear that changing the attributes of the CUSNO field will affect multiple objects in the application.

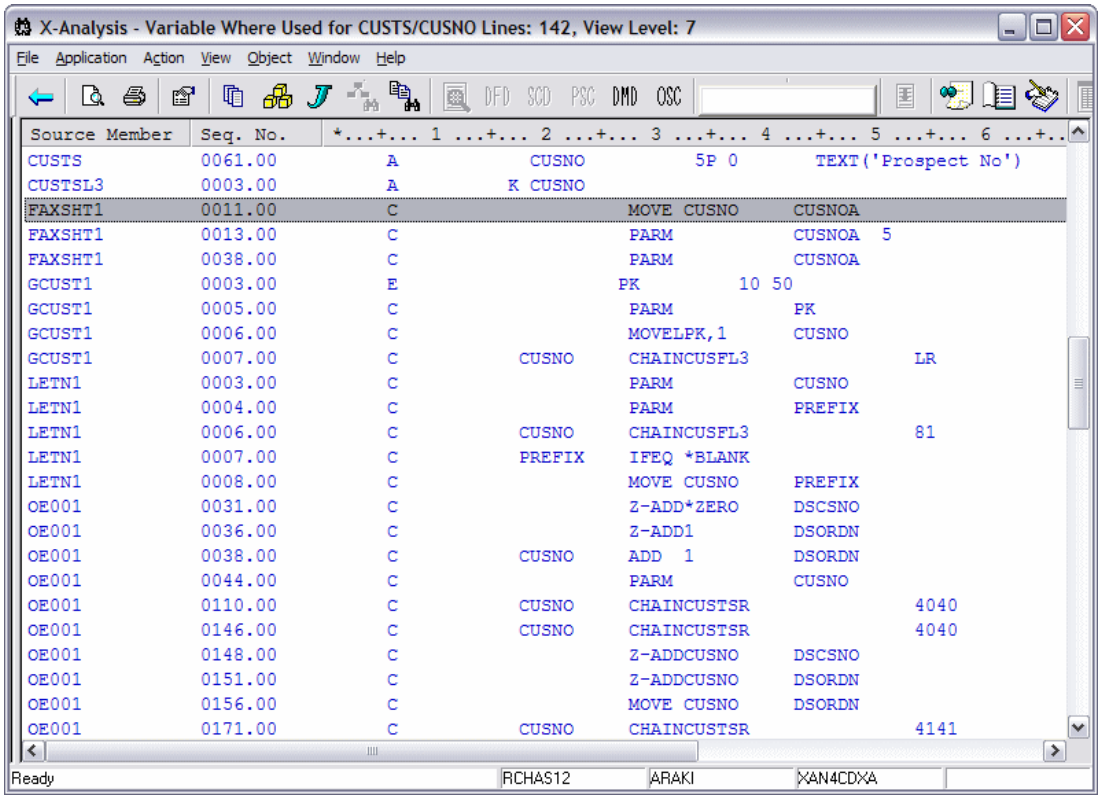
X-Analysis - Variable Where Used for CUSTS/CUSNO Lines: 142, View Level: 7
File Application Action View Object Window Help
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+..
CUSTS 0061.00 A CUSNO 5P 0 TEXT('Prospect No')
CUSTSL3 0003.00 A K CUSNO
FAXSHT1 0011.00 C MOVE CUSNO CUSNOA
FAXSHT1 0013.00 C PARM CUSNOA 5
FAXSHT1 0038.00 C PARM CUSNOA
GCUST1 0003.00 E PK 10 50
GCUST1 0005.00 C PARM PK
GCUST1 0006.00 C MOVELPK,1 CUSNO
GCUST1 0007.00 C CUSNO CHAINCUSFL3 LR
LETN1 0003.00 C PARM CUSNO
LETN1 0004.00 C PARM PREFIX
LETN1 0006.00 C CUSNO CHAINCUSFL3 81
LETN1 0007.00 C PREFIX IFEQ *BLANK
LETN1 0008.00 C MOVE CUSNO PREFIX
OE001 0031.00 C Z-ADD*ZERO DSCSNO
OE001 0036.00 C Z-ADD1 DSORDN
OE001 0038.00 C CUSNO ADD 1 DSORDN
OE001 0044.00 C PARM CUSNO
OE001 0110.00 C CUSNO CHAINCUSTSR 4040
OE001 0146.00 C CUSNO CHAINCUSTSR 4040
OE001 0148.00 C Z-ADDCUSNO DSCSNO
OE001 0151.00 C Z-ADDCUSNO DSORDN
OE001 0156.00 C MOVE CUSNO DSORDN
OE001 0171.00 C CUSNO CHAINCUSTSR 4141
Ready RCHAS12 ARAKI XAN4CDXA

Figure 4-11 Variable Where Used for CUSTS/CUSNO - Level 7

13. We now examine the impact that such a change would have on one particular program, FAXSHT1. Make sure that the VWU level is set to 7 (Maximum tracking) and locate sequence number 11.0 for source member FAXSHT1.

14. Double-click the line with sequence number **11.0**. X-Analysis opens FAXSHT1 at the line (Figure 4-12).

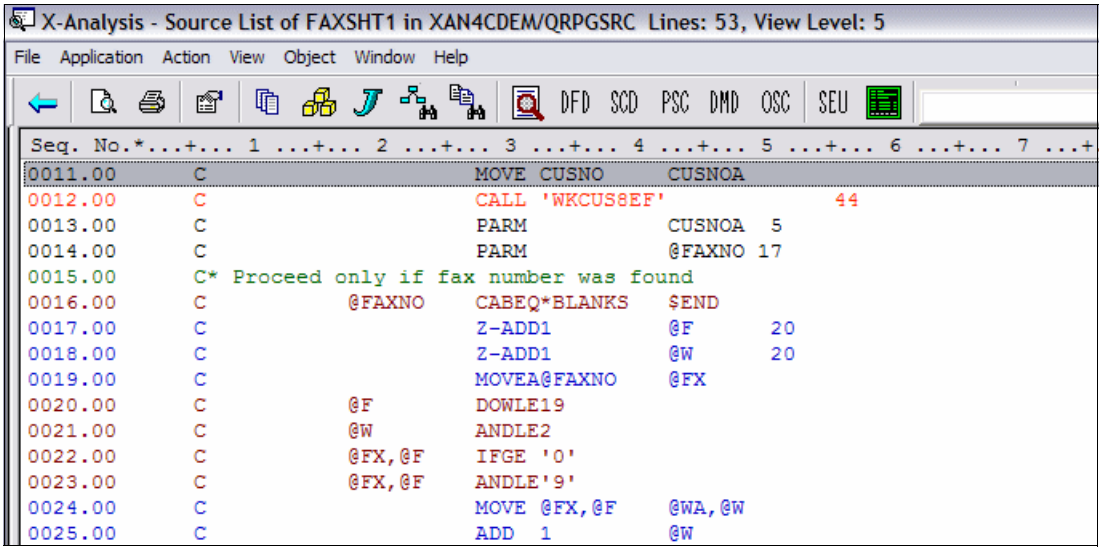
X-Analysis - Source List of FAXSHT1 in XAN4CDEM/QRPGSRC Lines: 53, View Level: 5
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
Seq. No.*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+
0011.00 C MOVE CUSNO CUSNOA
0012.00 C CALL 'WKCUS8EF' 44
0013.00 C PARM CUSNOA 5
0014.00 C PARM @FAXNO 17
0015.00 C* Proceed only if fax number was found
0016.00 C @FAXNO CABEQ*BLANKS $END
0017.00 C Z-ADD1 @F 20
0018.00 C Z-ADD1 @W 20
0019.00 C MOVEA@FAXNO @FX
0020.00 C @F DOWLE19
0021.00 C @W ANDLE2
0022.00 C @FX,@F IFGE '0'
0023.00 C @FX,@F ANDLE'9'
0024.00 C MOVE @FX,@F @WA,@W
0025.00 C ADD 1 @W

Figure 4-12 Source list highlighting the field reference

As CUSNO is moved to CUSNOA, any changes made to CUSNO will also apply to CUSNOA. By selecting the Member X-Ref for CUSNOA, you view all instances of CUSNOA and see how any changes to the end field will affect the application. Member X-Reference lists all source lines where CUSNOA has been referenced, in the member source and its associated device files and copybooks.

15. Right-click **CUSNOA** → **Member X-ref** from the option menu (Figure 4-13).

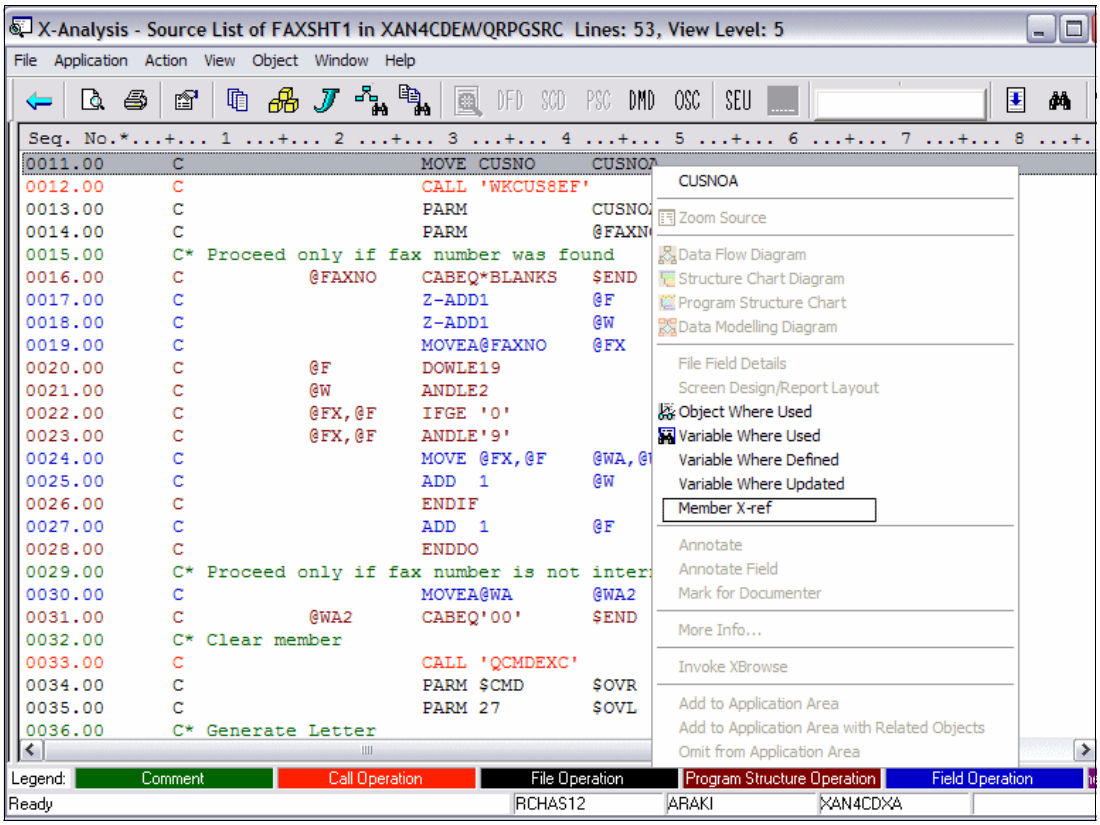

Figure 4-13 Right-click menu on field CUSNOA

You can see that CUSNOA is referenced in three places. (Figure 4-14)

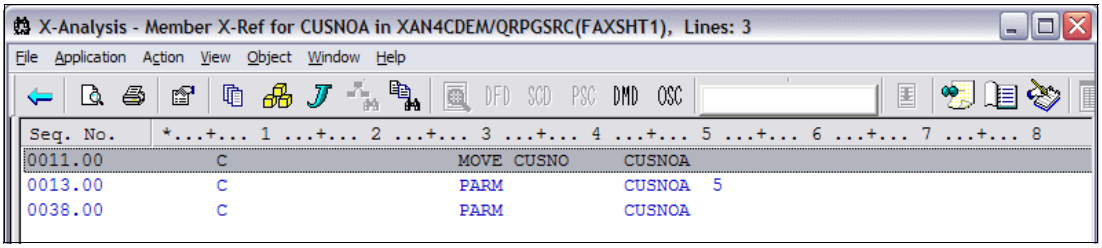
X-Analysis - Member X-Ref for CUSNOA in XAN4CDEM/QRPGSRC(FAXSHT1), Lines: 3
File Application Action View Object Window Help
0011.00 C MOVE CUSNO CUSNOA
0013.00 C PARM CUSNOA 5
0038.00 C PARM CUSNOA

Figure 4-14 Member X-ref for the field

16. Double-click the line for sequence number **13.00**. Although line 13.00 remains highlighted, the source browser view is repositioned and the entire source file member is displayed (Figure 4-15). You can now scroll up and down the listing to view the context.

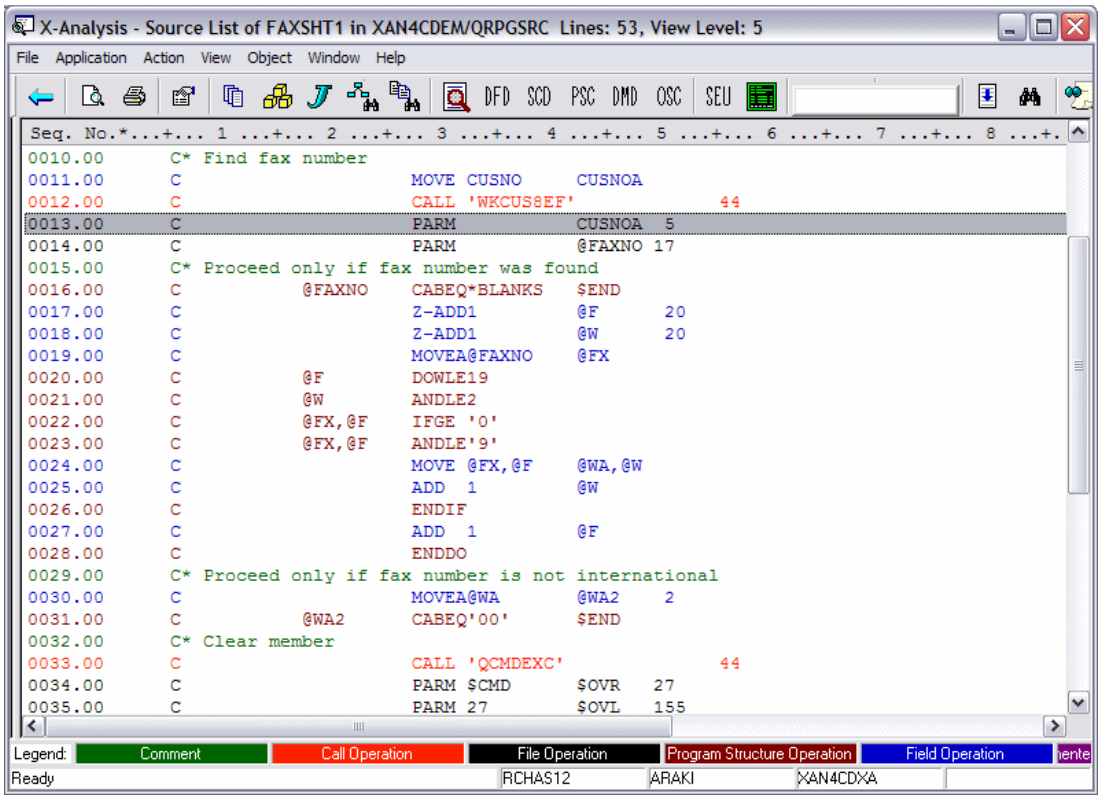
X-Analysis - Source List of FAXSHT1 in XAN4CDEM/QRPGSRC Lines: 53, View Level: 5
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
Seq. No.*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+... 8 ...+.
0010.00 C* Find fax number
0011.00 C MOVE CUSNO CUSNOA
0012.00 C CALL 'WKCUS8EF' 44
0013.00 C PARM CUSNOA 5
0014.00 C PARM @FAXNO 17
0015.00 C* Proceed only if fax number was found
0016.00 C @FAXNO CABEQ*BLANKS $END
0017.00 C Z-ADD1 @F 20
0018.00 C Z-ADD1 @W 20
0019.00 C MOVEA@FAXNO @FX
0020.00 C @F DOWLE19
0021.00 C @W ANDLE2
0022.00 C @FX,@F IFGE '0'
0023.00 C @FX,@F ANDLE'9'
0024.00 C MOVE @FX,@F @WA,@W
0025.00 C ADD 1 @W
0026.00 C ENDIF
0027.00 C ADD 1 @F
0028.00 C ENDDO
0029.00 C* Proceed only if fax number is not international
0030.00 C MOVEA@WA @WA2 2
0031.00 C @WA2 CABEQ'00' $END
0032.00 C* Clear member
0033.00 C CALL 'QCMDEXC' 44
0034.00 C PARM $CMD $OVR 27
0035.00 C PARM 27 $OVL 155
Legend: Comment Call Operation File Operation Program Structure Operation Field Operation
Ready RCHAS12 ARAKI XAN4CDXA

Figure 4-15 Source browser view with the selected line highlighted

As you can see, CUSNOA is a parameter passed to a program WKCUS8EF. The process can begin again by zooming into WKCUS8EF to track the impact on the parameters.

4.3 Application analysis and documentation

A primary objective of X-Analysis is to facilitate understanding of existing applications. By enabling the user to rapidly build a conceptual view of the components to be maintained, performing the necessary code updates will be faster.

X-Analysis produces three different diagram types at the object level:

- Data Flow Diagrams (DFD)
- Structure Chart Diagrams (SCD)
- Data Model Diagrams (also referred to as Entity Relationship Diagrams). Data Model Diagrams are more fully described in “Exploring the application data model” on page 200.

Two diagrams are also at the application area level:

- Overview Structure Charts (OSC)
- Application Area Data Model Diagrams

Each of these diagrams can be produced at both a detailed and an outline level. A detailed DFD also shows field usages between objects. A detailed SCD (OSC) also shows file usages.

4.3.1 Data Flow Diagrams (DFD)

X-Analysis enables you to see how the objects within an application relate to each other. In the following example, we examine how the CUSTS object relates to the whole application. Follow these steps to complete the example:

1. Locate the CMS application in the Application Libraries list on the left pane of the X-Analysis client window. Expand the **CMS** application and double-click **Source Files**. A list of all source files in the library appears in the right pane of the window.
2. Double-click **QDDSSRC** in the right pane of the window. All of the source file members in source file CMS/QDDSSRC appear in the right pane.
3. In the Member List view, locate and select the member named **CUSTS**, and click the Data Flow Diagram button (DFD) on the toolbar.

   The Object Centered Data flow diagram view (Figure 4-16) opens. This dataflow diagram represents a graphical equivalent of the Object Where Used on CUSTS. From this diagram you see how CUSTS fits into the application (the programs used to update CUSTS), and the various logical views and access paths of CUSTS.

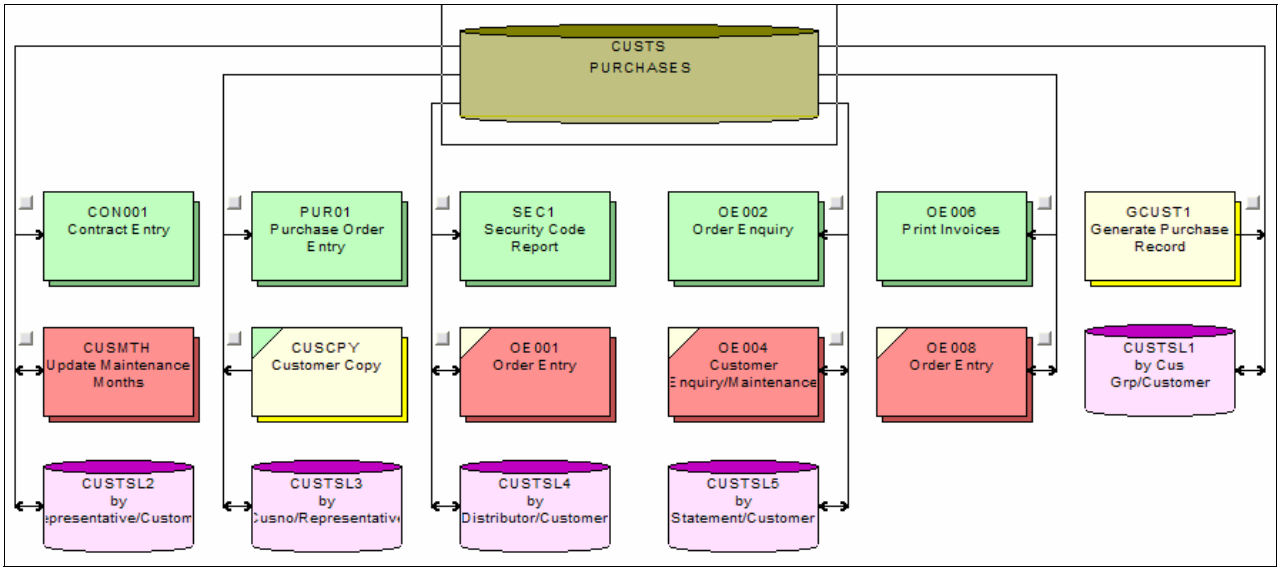

Figure 4-16 Object Centered Data Flow Diagram for CUSTS

The type of Objects in the Data Flow Diagram may be interpreted using the color-coded legend bar (Figure 4-17) at the bottom of the window.

Figure 4-17 Data Flow Diagram Legend Bar

4. To view field usage for any program, click the small gray button beside the program (Figure 4-18). This box may be located on either side of the program.

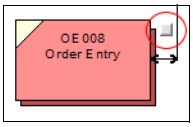

Figure 4-18 Field usage button on DFD item

The field usage dialog (Figure 4-19) opens.

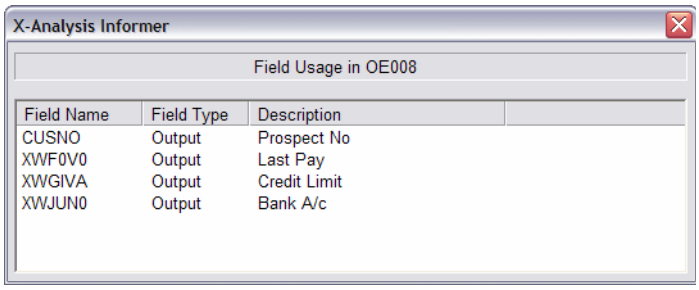

Figure 4-19 X-Analysis Informer displaying Field usage by OE008

> Note: X-Analysis determines the exact usage of each field by examining the detail of the underlying source code.

5. The field usage of all the programs may be viewed at a glance in the Detailed Data Flow Diagram (DFD) (Figure 4-20); select **View** → **Detailed DFD** from the toolbar menu.

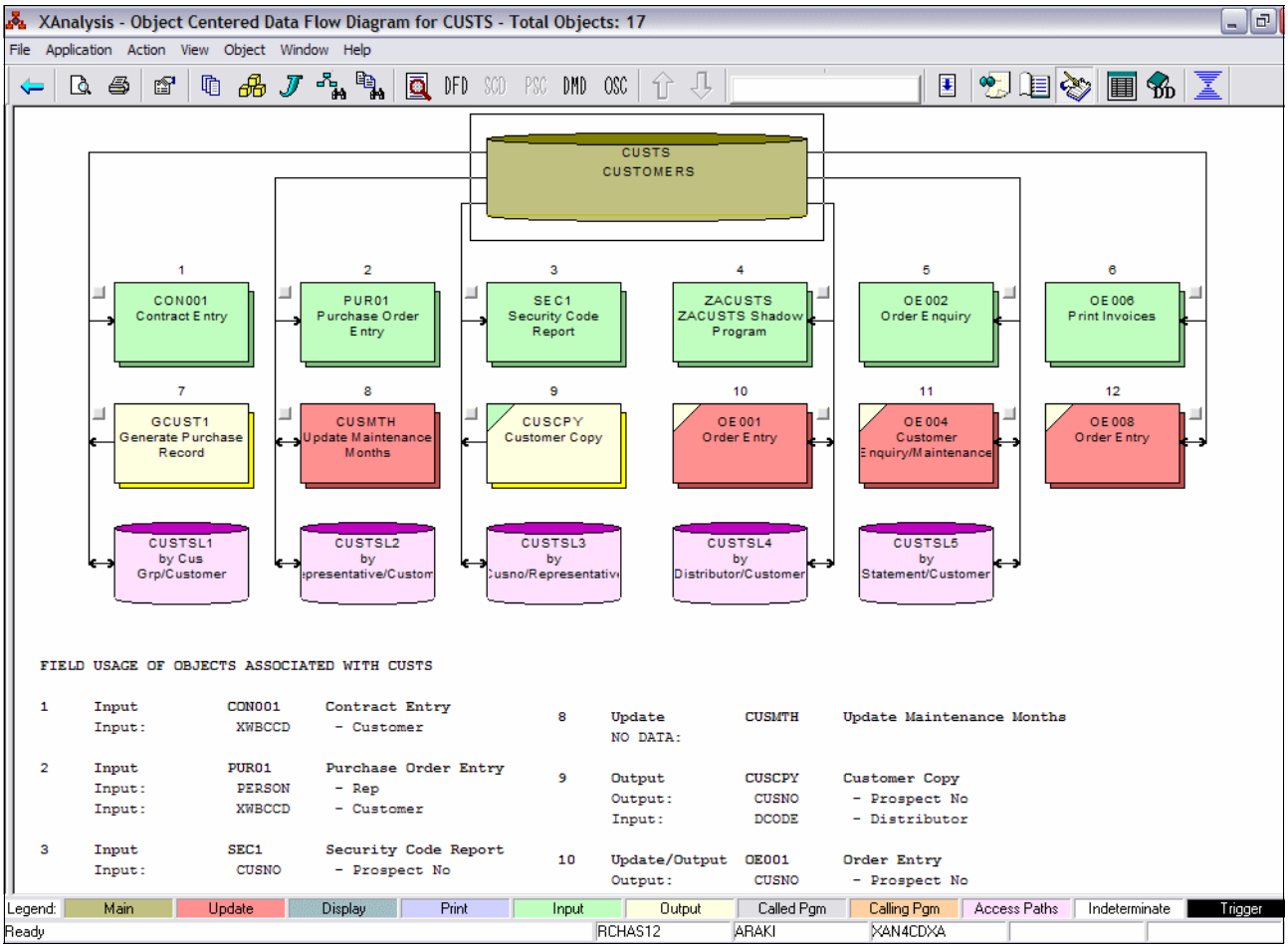
XAnalysis - Object Centered Data Flow Diagram for CUSTS - Total Objects: 17
File Application Action View Object Window Help
CUSTS
CUSTOMERS
CON001 Contract Entry
PUR01 Purchase Order Entry
SEC1 Security Code Report
ZACUSTS ZACUSTS Shadow Program
OE002 Order Enquiry
OE006 Print Invoices
GCUST1 Generate Purchase Record
CUSMTH Update Maintenance Months
CUSCPY Customer Copy
OE001 Order Entry
OE004 Customer Enquiry/Maintenance
OE008 Order Entry
CUSTSL1 by Cus Grp/Customer
CUSTSL2 by presentative/Custom
CUSTSL3 by Cusno/Representativ
CUSTSL4 by Distributor/Customer
CUSTSL5 by Statement/Customer
FIELD USAGE OF OBJECTS ASSOCIATED WITH CUSTS
1 Input CON001 Contract Entry
Input: XWBCCD - Customer
2 Input PUR01 Purchase Order Entry
Input: PERSON - Rep
Input: XWBCCD - Customer
3 Input SEC1 Security Code Report
Input: CUSNO - Prospect No
8 Update CUSMTH Update Maintenance Months
NO DATA:
9 Output CUSCPY Customer Copy
Output: CUSNO - Prospect No
Input: DCODE - Distributor
10 Update/Output OE001 Order Entry
Output: CUSNO - Prospect No
Legend: Main Update Display Print Input Output Called Pgm Calling Pgm Access Paths Indeterminate Trigger
Ready
RCHAS12
ARAKI
XAN4CDXA

Figure 4-20 Data Flow Diagram for CUSTS (Detailed DFD View)

6. To bring up the DFD for program OE001, double-click the **OE001** icon.

The DFD for OE001 appears (Figure 4-21). You can browse through a single large model. However, closer inspection reveals that in the case of a program that is not called by any other program, a double-click does not lead to another Data Flow Diagram.

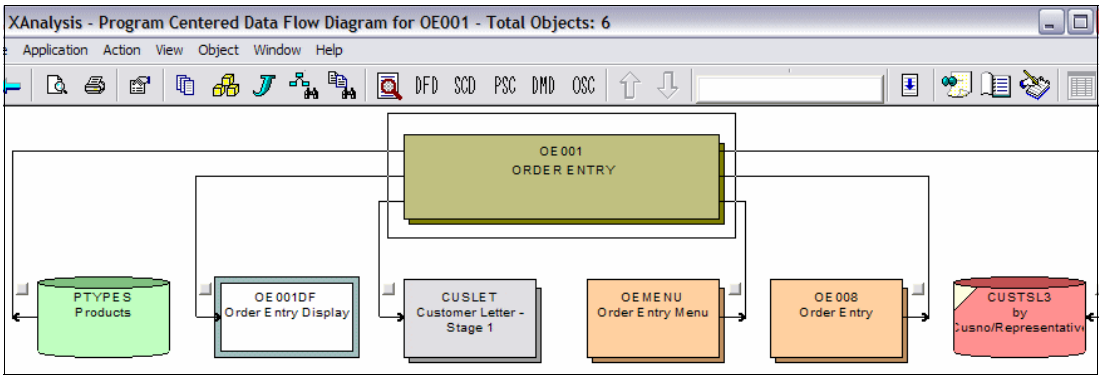

Figure 4-21 Data Flow Diagram for OE001

4.3.2 Structure Chart Diagram (SCD)

The structure chart is a nested tree diagram that shows the programs called and information about those programs.

To bring up the Structure Chart Diagram for OE001, right-click **OEMEMU** → **Structure Chart Diagram**. The Structure Chart Diagram for OEMENU appears (Figure 4-22).

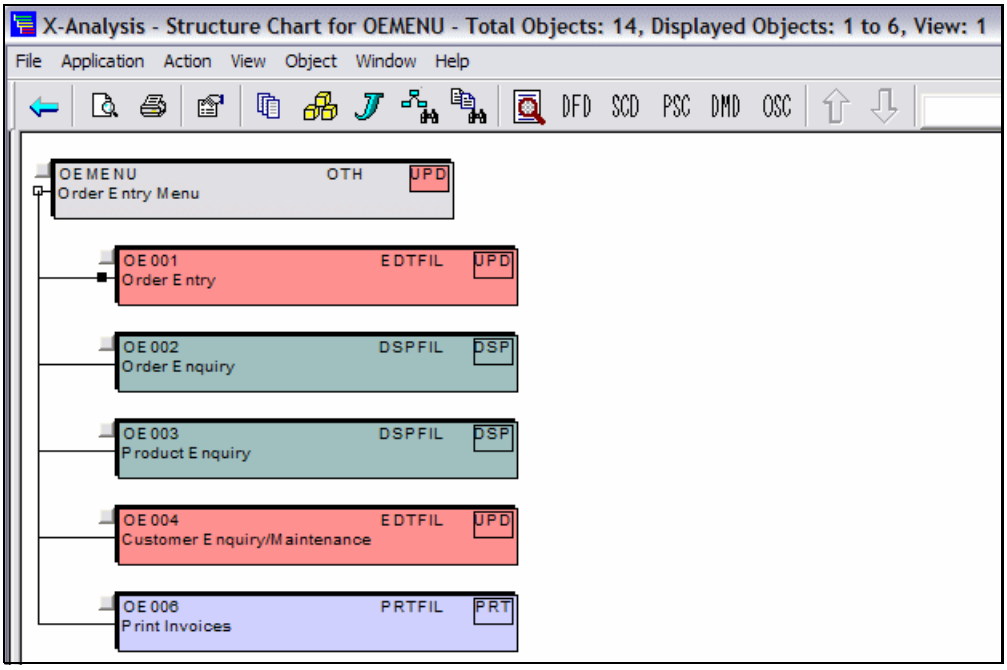
X-Analysis - Structure Chart for OEMENU - Total Objects: 14, Displayed Objects: 1 to 6, View: 1
File Application Action View Object Window Help
DFD SCD PSC DMD OSC
OEMENU OTH UPD
Order Entry Menu
OE001 EDTFIL UPD
Order Entry
OE002 DSPFIL DSP
Order Enquiry
OE003 DSPFIL DSP
Product Enquiry
OE004 EDTFIL UPD
Customer Enquiry/Maintenance
OE006 PRTFIL PRT
Print Invoices

Figure 4-22 OEMENU Structure Chart

OEMENU calls five programs. The nature of the called programs may be ascertained through the color-coded Structure Chart legend at the bottom of the screen (Figure 4-23).

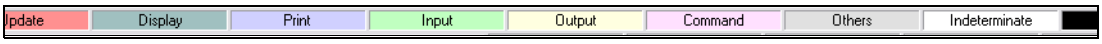

Figure 4-23 Structure Chart Legend

Detailed Structure Chart

The detailed structure chart shows the files used by each program together with the automatically generated program text. This text is automatically recovered by X-Analysis from the application and it describes the program's purpose.

To see an example of this, complete the following steps:

1. From the toolbar menu, select **View** → **Detailed DFD**. The detailed structure chart for OEMENU appears (Figure 4-24).

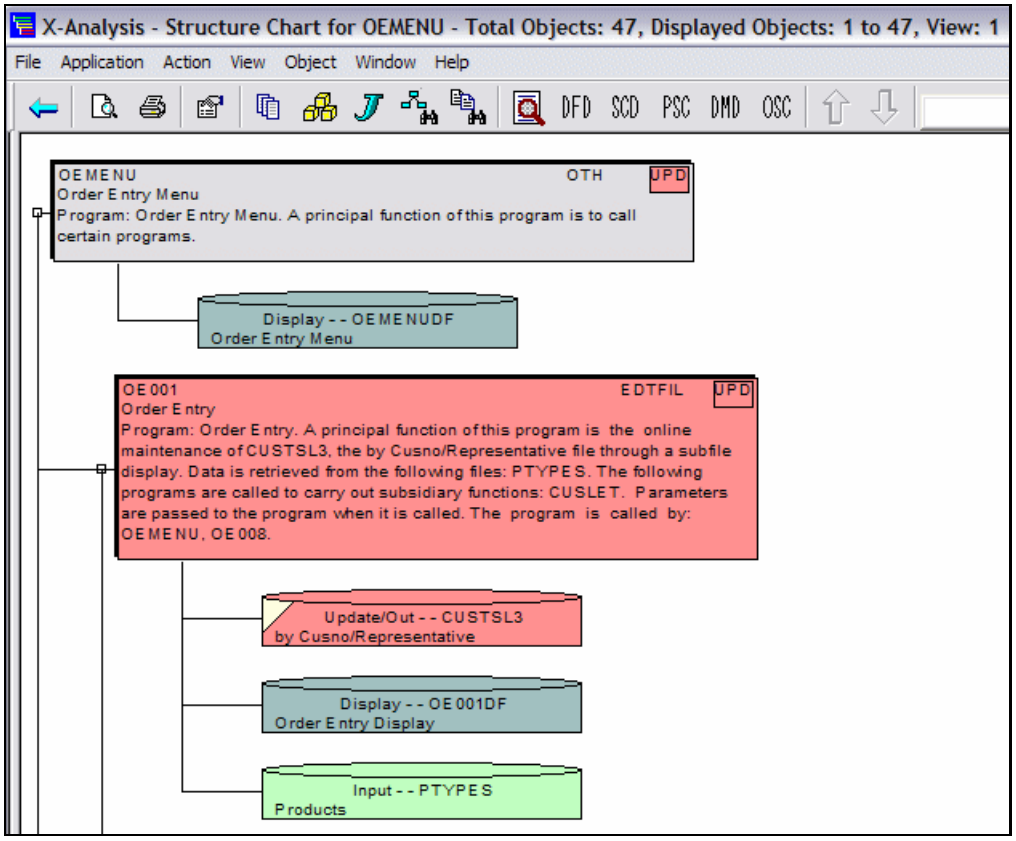
X-Analysis - Structure Chart for OEMENU - Total Objects: 47, Displayed Objects: 1 to 47, View: 1
File Application Action View Object Window Help
DFD SCD PSC DMD OSC
OEMENU OTH UPD
Order Entry Menu
Program: Order Entry Menu. A principal function of this program is to call certain programs.
Display - - OEMENUDF
Order Entry Menu
OE001 EDTFIL UPD
Order Entry
Program: Order Entry. A principal function of this program is the online maintenance of CUSTSL3, the by Cusno/Representative file through a subfile display. Data is retrieved from the following files: PTYPES. The following programs are called to carry out subsidiary functions: CUSLET. Parameters are passed to the program when it is called. The program is called by: OEMENU, OE008.
Update/Out - - CUSTSL3
by Cusno/Representative
Display - - OE001DF
Order Entry Display
Input - - PTYPES
Products

Figure 4-24 OEMENU detailed Structure Chart

2. All of these charts can be printed. To see a print preview, click the Print Preview button. Figure 4-25 shows the print preview of OEMENU view ().

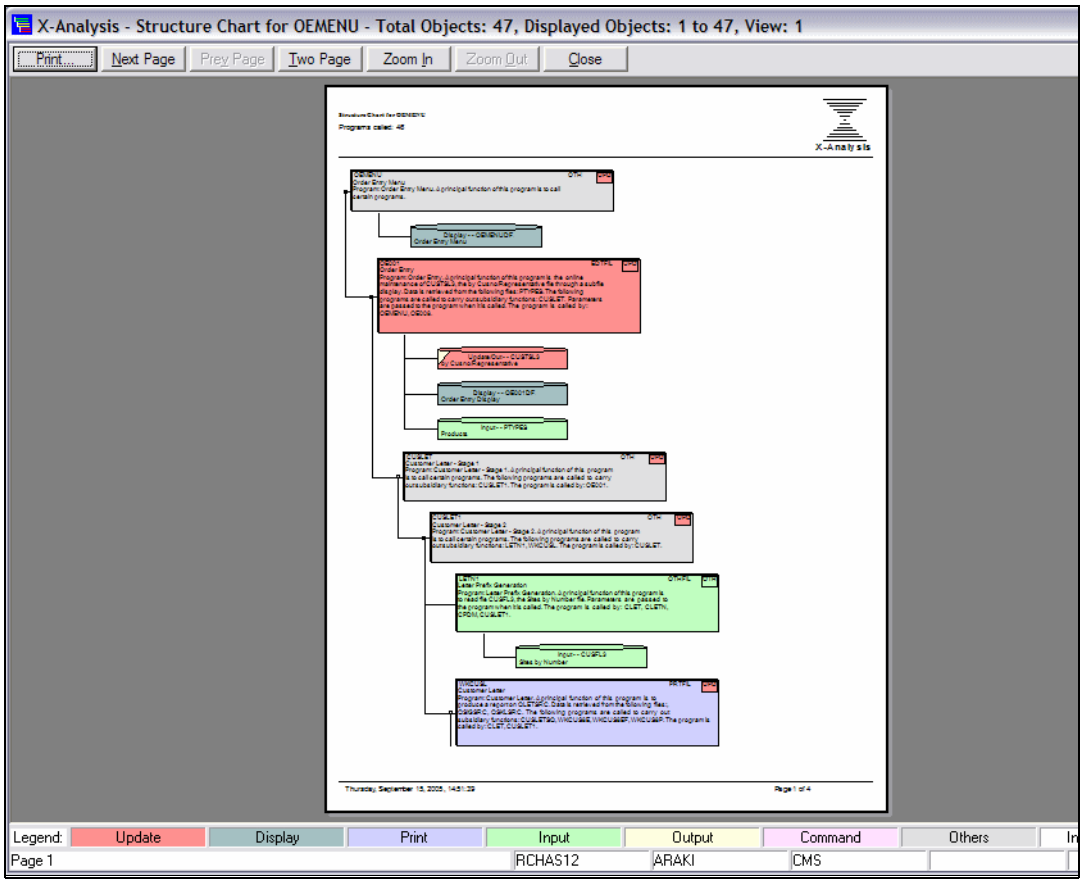

Figure 4-25 Print preview of OEMENU detailed Structure Chart

This can be printed if required. Close the print preview and return to the detailed structure chart.

Note: All diagrams are fully interactive. From any selected object, it is possible to select another diagram or zoom into the source code.

Document Manager

The Document Manager facilitates the generation of Microsoft Word documents containing system design information for the specified objects.

Mark for Document Manager

The following steps show you how to mark documentation:

1. The object to be documented must be marked for documentation. To do this, in the Detailed Structure Chart diagram, follow one of these methods:
   - Method 1: Right-click **OEMENU** → **Mark for Documenter** (Figure 4-26).

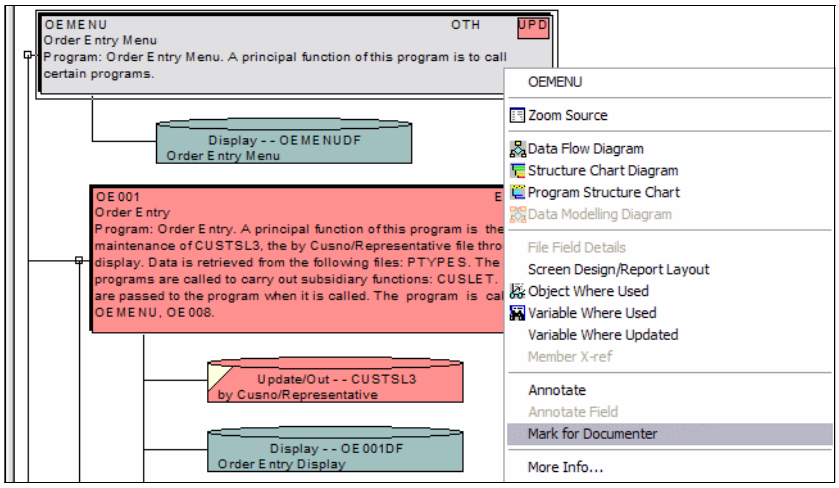
OEMENU
OTH
UPD
Order Entry Menu
Program: Order Entry Menu. A principal function of this program is to call certain programs.
Display - - OEMENUDF
Order Entry Menu
OE001
Order Entry
Program: Order Entry. A principal function of this program is the maintenance of CUSTSL3, the by Cusno/Representative file thro display. Data is retrieved from the following files: PTYPES. The programs are called to carry out subsidiary functions: CUSLET. are passed to the program when it is called. The program is cal OEMENU, OE008.
Update/Out - - CUSTSL3
by Cusno/Representative
Display - - OE001DF
Order Entry Display
OEMENU
Zoom Source
Data Flow Diagram
Structure Chart Diagram
Program Structure Chart
Data Modelling Diagram
File Field Details
Screen Design/Report Layout
Object Where Used
Variable Where Used
Variable Where Updated
Member X-ref
Annotate
Annotate Field
Mark for Documenter
More Info...

Figure 4-26 Right-click menu on OEMENU in Detailed Structure Chart Diagram

   - Method 2: From the toolbar menu, click **OEMENU** → **Object** → **Mark for Documenter** or **Mark all for Documenter** (Figure 4-27).

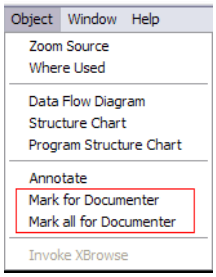

Figure 4-27 Mark for Documenter

2. Next, mark two more objects for the documenter. To go back to the Data Flow Diagram of CUST, click the return button twice.
3. Right-click **CUSTS** → **Mark for Documenter**.
4. Right-click **OE001** → **Mark for Documenter**.

> **Note:** The shortcut key for the Return button is Ctrl + Backspace.

5. To open the Document Manager window, click the Documenter button.

6. The Document Manager dialog box appears (Figure 4-28). Click **Generate Document**.

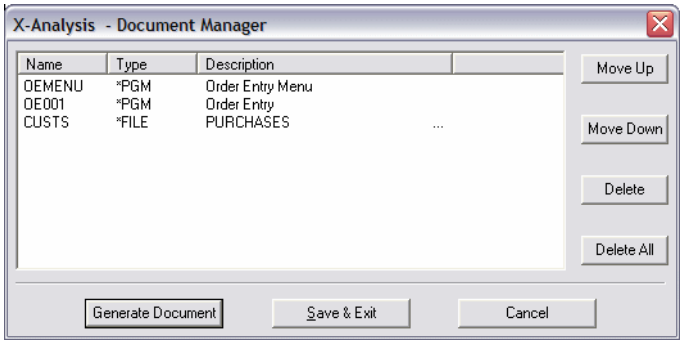

Figure 4-28 Document Manager

7. The Documentation Process dialog box (Figure 4-29) opens. You can choose to generate a single document with documentation for all objects marked for documentation or individual documents for each object marked for documentation. Click **Generate Single System Document**.

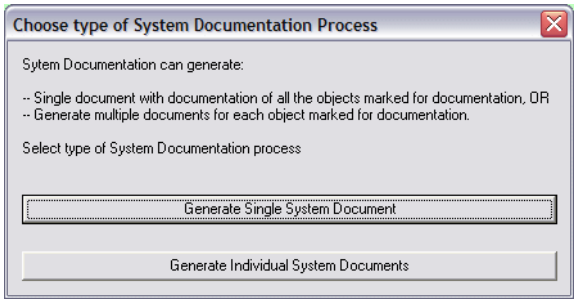
Choose type of System Documentation Process
Sytem Documentation can generate:
-- Single document with documentation of all the objects marked for documentation, OR
-- Generate multiple documents for each object marked for documentation.
Select type of System Documentation process
Generate Single System Document
Generate Individual System Documents

Figure 4-29 Documentation process dialog

8. The application document location dialog (Figure 4-30) opens. Enter a file name and click **Save**.

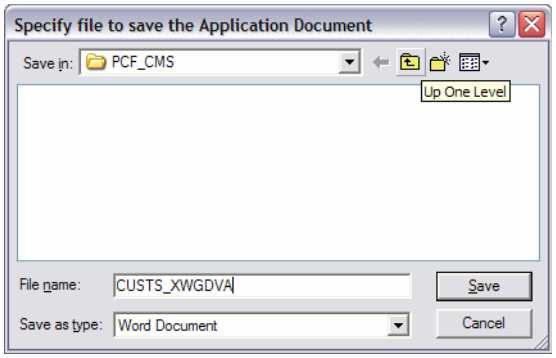

Figure 4-30 Application document location dialog

9. The System Documentation Wizard - Start window (Figure 4-31) opens. Click **Next**.

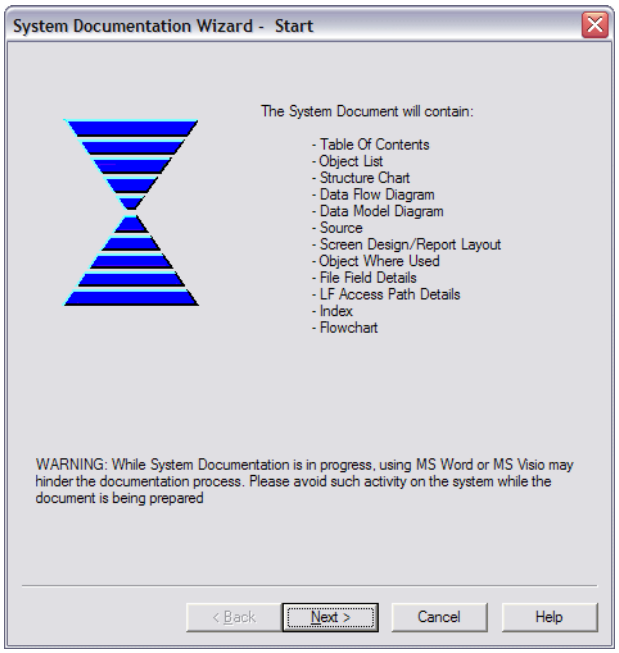
System Documentation Wizard - Start
The System Document will contain:
- Table Of Contents
- Object List
- Structure Chart
- Data Flow Diagram
- Data Model Diagram
- Source
- Screen Design/Report Layout
- Object Where Used
- File Field Details
- LF Access Path Details
- Index
- Flowchart
WARNING: While System Documentation is in progress, using MS Word or MS Visio may hinder the documentation process. Please avoid such activity on the system while the document is being prepared
< Back
Next >
Cancel
Help

Figure 4-31 System Documentation Wizard - Start Window

10. The System Documentation Wizard - Specify Contents window (Figure 4-32) opens. Click **Next**.

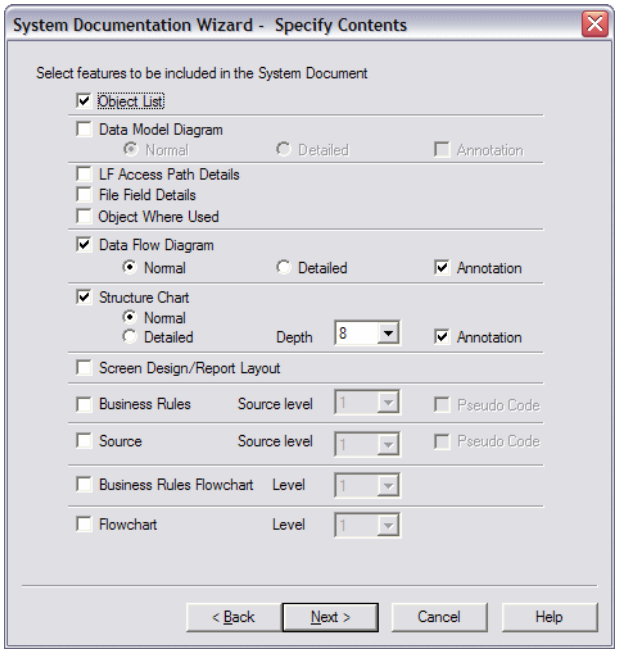

Figure 4-32 System Documentation Wizard - Specify Contents window

11. The System Documentation Wizard - Specify Sequence window (Figure 4-33) opens. Confirm the sequence of the documentation and click **Next**.

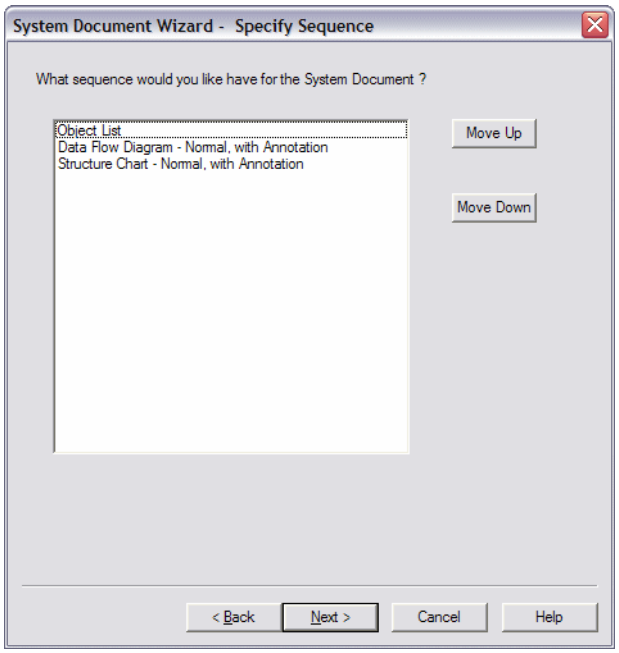
System Document Wizard - Specify Sequence
What sequence would you like have for the System Document ?
Object List
Data Flow Diagram - Normal, with Annotation
Structure Chart - Normal, with Annotation
Move Up
Move Down
< Back
Next >
Cancel
Help

Figure 4-33 System Documentation Wizard - Specify Sequence window

12. The System Documentation Wizard - Finish window (Figure 4-34) opens. To complete the operation, click **Finish**.

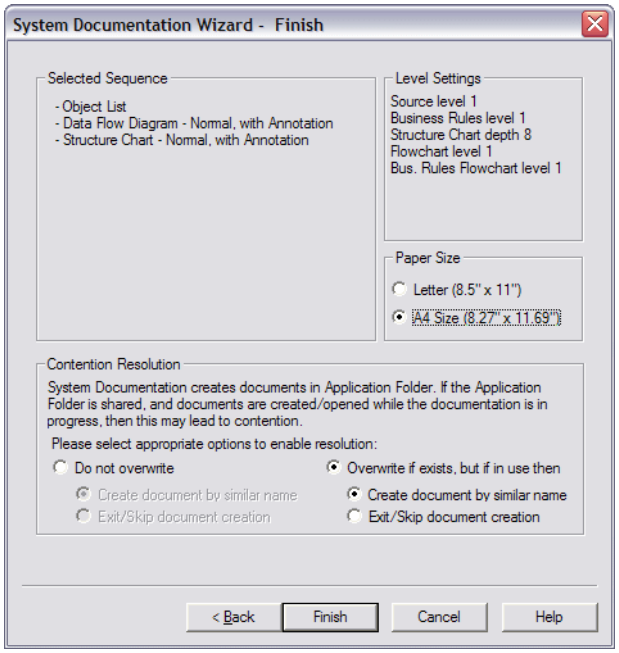
System Documentation Wizard - Finish
Selected Sequence
- Object List
- Data Flow Diagram - Normal, with Annotation
- Structure Chart - Normal, with Annotation
Level Settings
Source level 1
Business Rules level 1
Structure Chart depth 8
Flowchart level 1
Bus. Rules Flowchart level 1
Paper Size
Letter (8.5" x 11")
A4 Size (8.27" x 11.69")
Contention Resolution
System Documentation creates documents in Application Folder. If the Application Folder is shared, and documents are created/opened while the documentation is in progress, then this may lead to contention.
Please select appropriate options to enable resolution:
Do not overwrite
Create document by similar name
Exit/Skip document creation
Overwrite if exists, but if in use then
Create document by similar name
Exit/Skip document creation
< Back
Finish
Cancel
Help

Figure 4-34 System Documentation Wizard - Finish window

The documenter runs, producing the required documentation. The documenter creates a table of contents and an index as well.

The document that has been produced can be viewed in Microsoft Word (Figure 4-35) from its saved location.

Note: Flow charts are generated using Microsoft Visio and are shown as hyperlinks in the MS Word document.

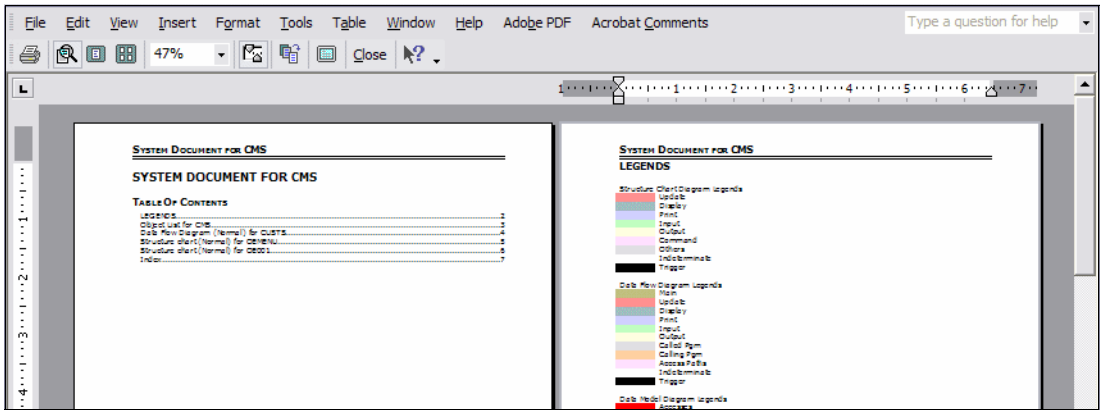
File Edit View Insert Format Tools Table Window Help Adobe PDF Acrobat Comments
Type a question for help
47%
Close
System Document for CMS
SYSTEM DOCUMENT FOR CMS
Table Of Contents
System Document for CMS
LEGENDS

Figure 4-35 Print Preview of the System Document

Note: The System Documentation Wizard displays a warning message at the bottom:

```
WARNING: While System Documentation is in progress, using MS Word or Visio may hinder
the documentation process. Please avoid such activity on the system while the
document is being prepared.
```

4.4 Program analysis and understanding

X-Analysis uses another set of constructs against the cross-reference repository to facilitate individual program understanding.

The program analysis facilities consist of:

- The source browser
- Variable Where Used
- Member X-Reference
- Viewing source at different detail levels
- Indented source
- Pseudo code displays
- Program flowchart
- MS Visio
- Business Rule displays

In the following section, each one of these facilities is described in detail.

4.4.1 The Source Browser

The Source Browser displays the source code of an object and can be invoked in one of three ways:

- The right-click menu on any member or object on the Member/Object list. This presents Zoom Source as the first option, which opens the source of an object or member in the Source Browser.

- Double-click any member or object on the Member/Object list to open the member source in the Source Browser view.
- Use the “Jump to” button on the tool bar.

To view the source listing of the file CUSTS, follow these steps:

1. Double-click the **CUSTS** record in the Member List View.
2. Click the Jump to button on the tool bar or click the **CUSTS** record and press Enter. In the Jump to dialog (Figure 4-36), select **Zoom Source here**.

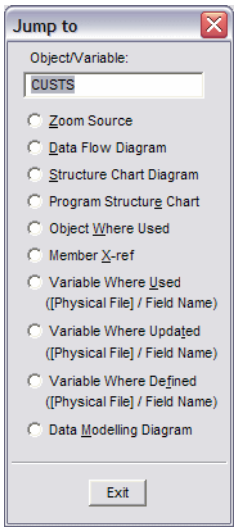

Figure 4-36 Jump to dialog

The source code listing for file CUSTS opens in the Source Browser (Figure 4-37).

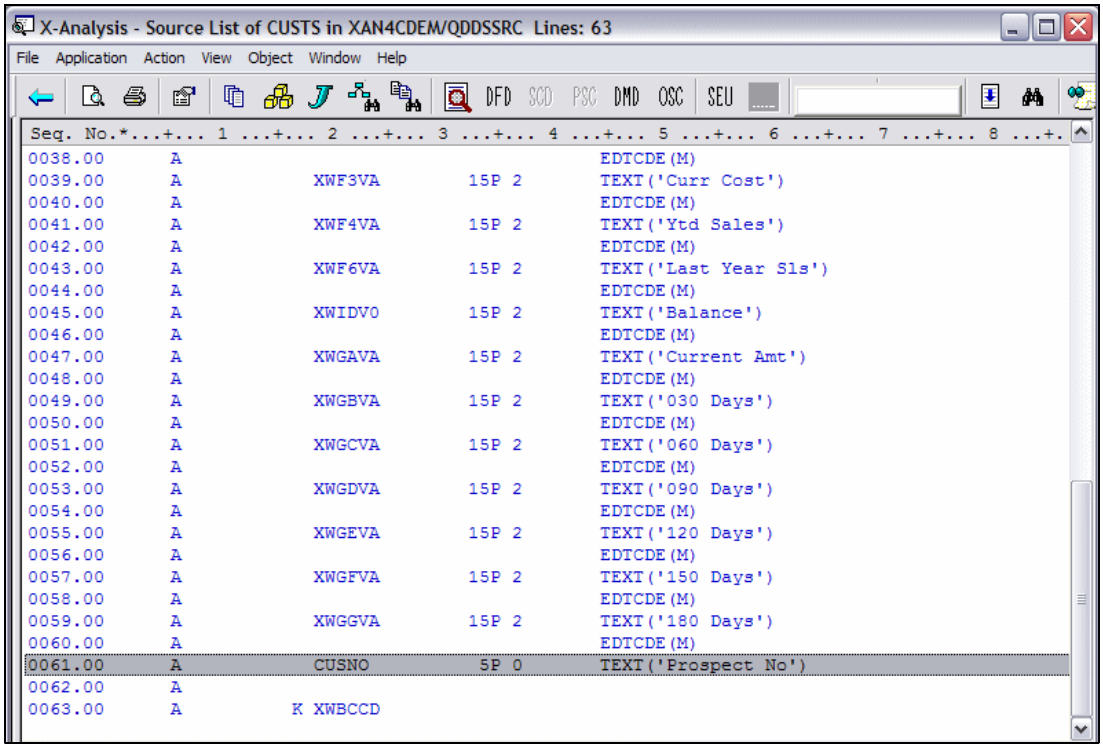
X-Analysis - Source List of CUSTS in XAN4CDEM/QDDSSRC Lines: 63
File Application Action View Object Window Help
Seq. No.*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+... 8 ...+.
0038.00 A EDTCDE(M)
0039.00 A XWF3VA 15P 2 TEXT('Curr Cost')
0040.00 A EDTCDE(M)
0041.00 A XWF4VA 15P 2 TEXT('Ytd Sales')
0042.00 A EDTCDE(M)
0043.00 A XWF6VA 15P 2 TEXT('Last Year Sls')
0044.00 A EDTCDE(M)
0045.00 A XWIDV0 15P 2 TEXT('Balance')
0046.00 A EDTCDE(M)
0047.00 A XWGAVA 15P 2 TEXT('Current Amt')
0048.00 A EDTCDE(M)
0049.00 A XWGBVA 15P 2 TEXT('030 Days')
0050.00 A EDTCDE(M)
0051.00 A XWGCVA 15P 2 TEXT('060 Days')
0052.00 A EDTCDE(M)
0053.00 A XWGDVA 15P 2 TEXT('090 Days')
0054.00 A EDTCDE(M)
0055.00 A XWGEVA 15P 2 TEXT('120 Days')
0056.00 A EDTCDE(M)
0057.00 A XWGFVA 15P 2 TEXT('150 Days')
0058.00 A EDTCDE(M)
0059.00 A XWGGVA 15P 2 TEXT('180 Days')
0060.00 A EDTCDE(M)
0061.00 A CUSNO 5P 0 TEXT('Prospect No')
0062.00 A
0063.00 A K XWBCCD

Figure 4-37 Source List of CUSTS

4.4.2 Variable Where Used

The Variable Where Used (VWU) facility lists all of the source lines where the field or variable of a file or program has been referenced in the member source and its associated device files and copybooks, throughout the application. For further details about the VWU levels, refer to 4.2.1, “Variable Where Used” on page 114.

To display all references of CUSNO in CUSTS along with the associated line of code, complete the following steps:

1. Right-click the **CUSNO** in the Source List of CUSTS (Figure 4-38) and select **Variable Where Used**.

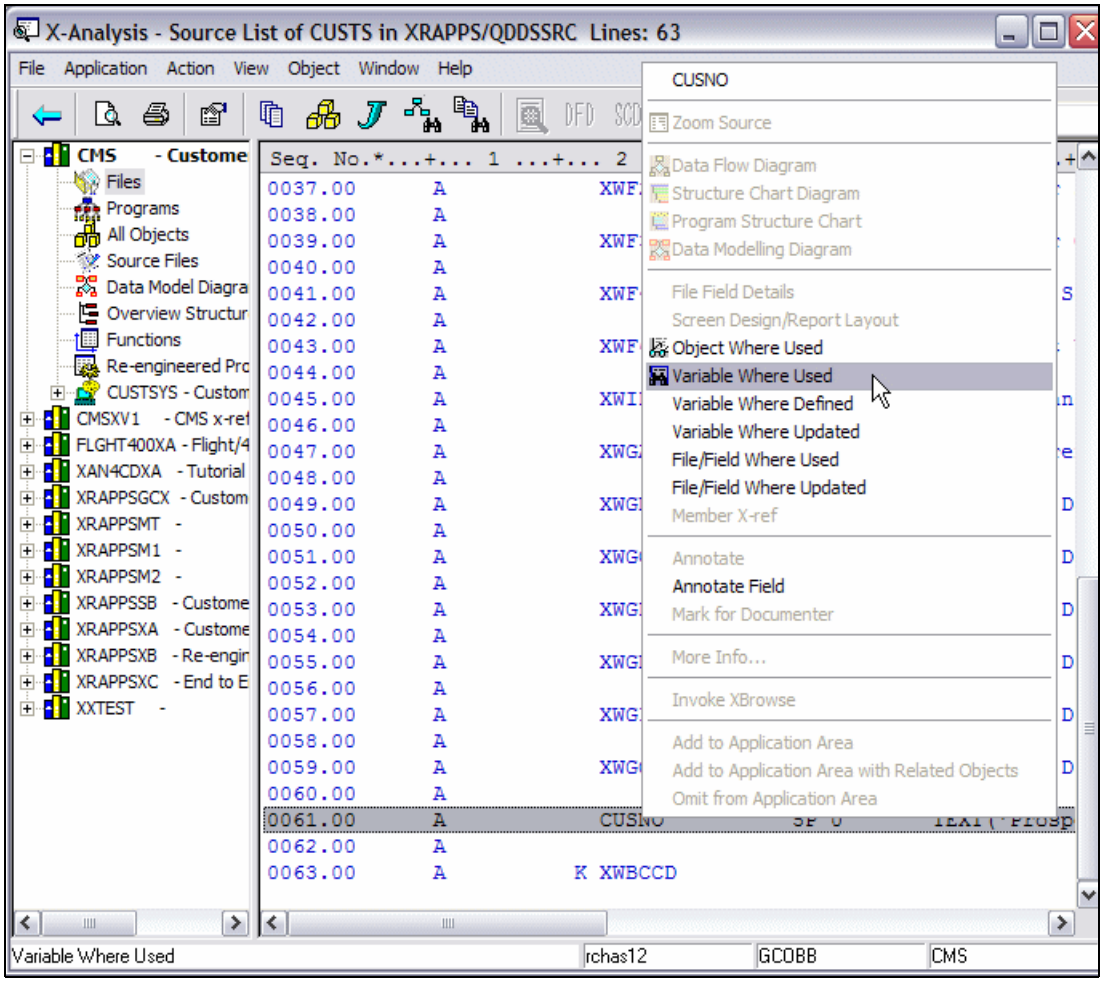

Figure 4-38 Source Lists of CUSTS

The Variable Where Used View opens (Figure 4-39). From this view you see all of the lines of all the source members that reference the CUSNO field.

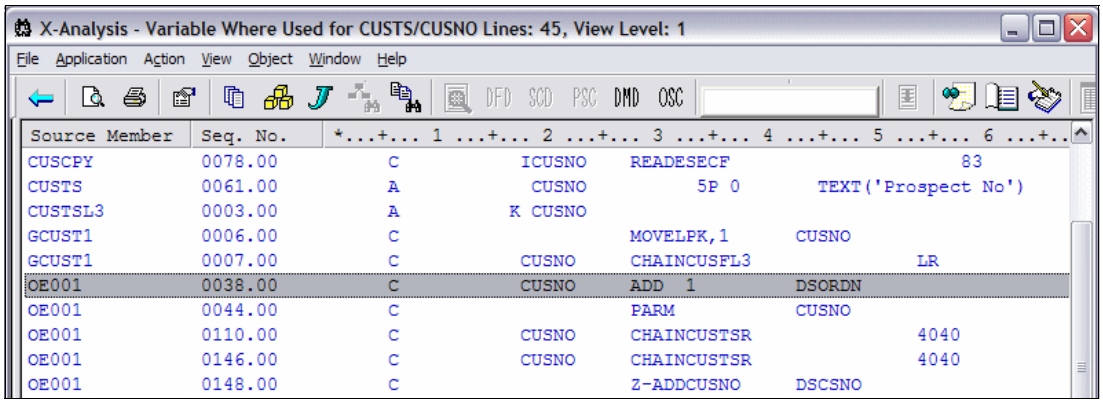
X-Analysis - Variable Where Used for CUSTS/CUSNO Lines: 45, View Level: 1
File Application Action View Object Window Help
DFD SCD PSC DMD OSC
Source Member Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+..
CUSCPY 0078.00 C ICUSNO READESECF 83
CUSTS 0061.00 A CUSNO 5P 0 TEXT('Prospect No')
CUSTSL3 0003.00 A K CUSNO
GCUST1 0006.00 C MOVELPK,1 CUSNO
GCUST1 0007.00 C CUSNO CHAINCUSFL3 LR
OE001 0038.00 C CUSNO ADD 1 DSORDN
OE001 0044.00 C PARM CUSNO
OE001 0110.00 C CUSNO CHAINCUSTSR 4040
OE001 0146.00 C CUSNO CHAINCUSTSR 4040
OE001 0148.00 C Z-ADDCUSNO DSCSNO

Figure 4-39 Variable Where Used View for CUSTS/CUSNO

4.4.3 Member X-Reference

Member X-Reference lists all of the source lines in which the selected field or variable has been used or referenced, in the member source (currently displayed) and its associated device files and copybooks. A wide variety of items can be specified including: files, array definitions, data structures, data structure sub-fields, indicators, key lists, data fields, file formats, subroutines, program variables, array elements, parameter lists, parameters, key fields, and EXCPT names.

Double-click a field in a member source to present the Member X-Reference view. Alternatively, you can choose **Member X-ref** using the right-click menu.

To perform a Member X-Reference on a variable, complete the following steps:

1. In the source list of source member OE001, the cursor is positioned on sequence number 38.00. Right-click the variable **DSORDN** and select **Member X-ref** (Figure 4-40).

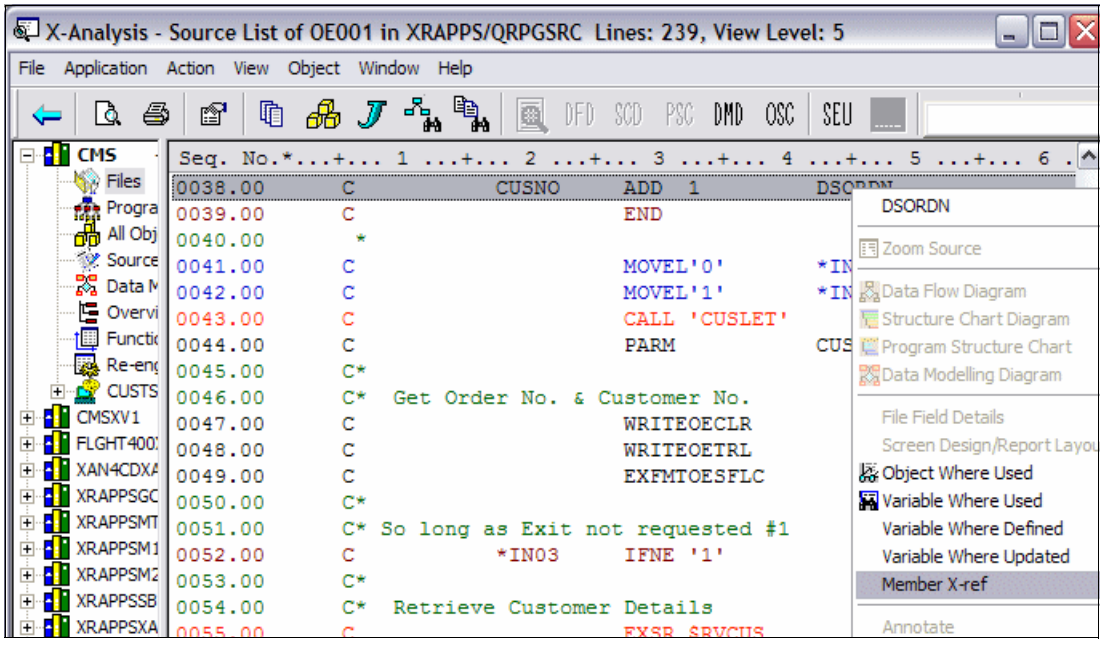

Figure 4-40 Source list of OE001

Member X-Ref for DSORDN view (Figure 4-41) opens. Here you see all references to the field DSORDN in OE001 and its associated device files.

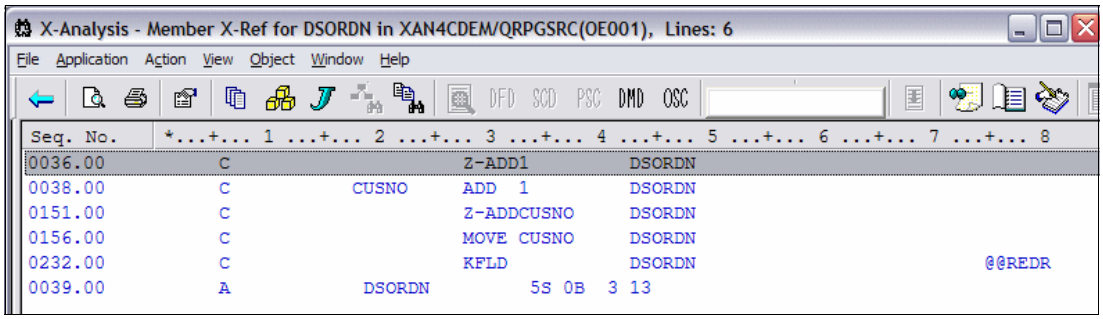
X-Analysis - Member X-Ref for DSORDN in XAN4CDEM/QRPGSRC(OE001), Lines: 6
File Application Action View Object Window Help
Seq. No. *...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+... 8
0036.00 C Z-ADD1 DSORDN
0038.00 C CUSNO ADD 1 DSORDN
0151.00 C Z-ADDCUSNO DSORDN
0156.00 C MOVE CUSNO DSORDN
0232.00 C KFLD DSORDN @@REDR
0039.00 A DSORDN 5S 0B 3 13

Figure 4-41 Member X-Ref for DSORDN

4.4.4 Viewing Source at different detail levels

The Member X-Reference may be viewed at various levels using the source levels in the View menu. The View levels range from1 to 5 and are available only for program objects. The View menu on this display allows for indentation and five levels of source listing. Each level suppresses certain source lines such as:

- Level 5 shows all source lines.
- Level 4 suppresses all blank lines and comments.
- Level 3 removes source lines having opcodes such as MOVE and ADD and presents the remaining source lines.
- Level 2 suppresses the source lines having opcodes such as IF/ELSE/END and DOW/DOU and leaves file information, comments, and so forth.
- Level 1 presents only the comments and the CALL/EXSR statements.

Source lines have the following color codes:

- Call operations such as CALL or ESXR are in red.
- Conditional constructs such as IF/ELSE/END, DO/WHILE, and DO/UNTIL are in dark brown.
- Field operations such as MOVE and ADD are in blue.
- Program structure statements are in dark magenta.
- Comments are in green.
- The rest of the source lines are in black.

In the following example, the source view level of program OE001 is changed to level 1. This reduces the number of source lines that are displayed. The source view level is then incrementally changed back up to level 5. Follow these steps to complete the example:

1. At the Member X-Ref for DSORDN screen, click the Return button on the tool bar to return to the OE001 Source Listing.

2. On the toolbar menu (Figure 4-42), select **View** → **Source Level** → **Level 1**.

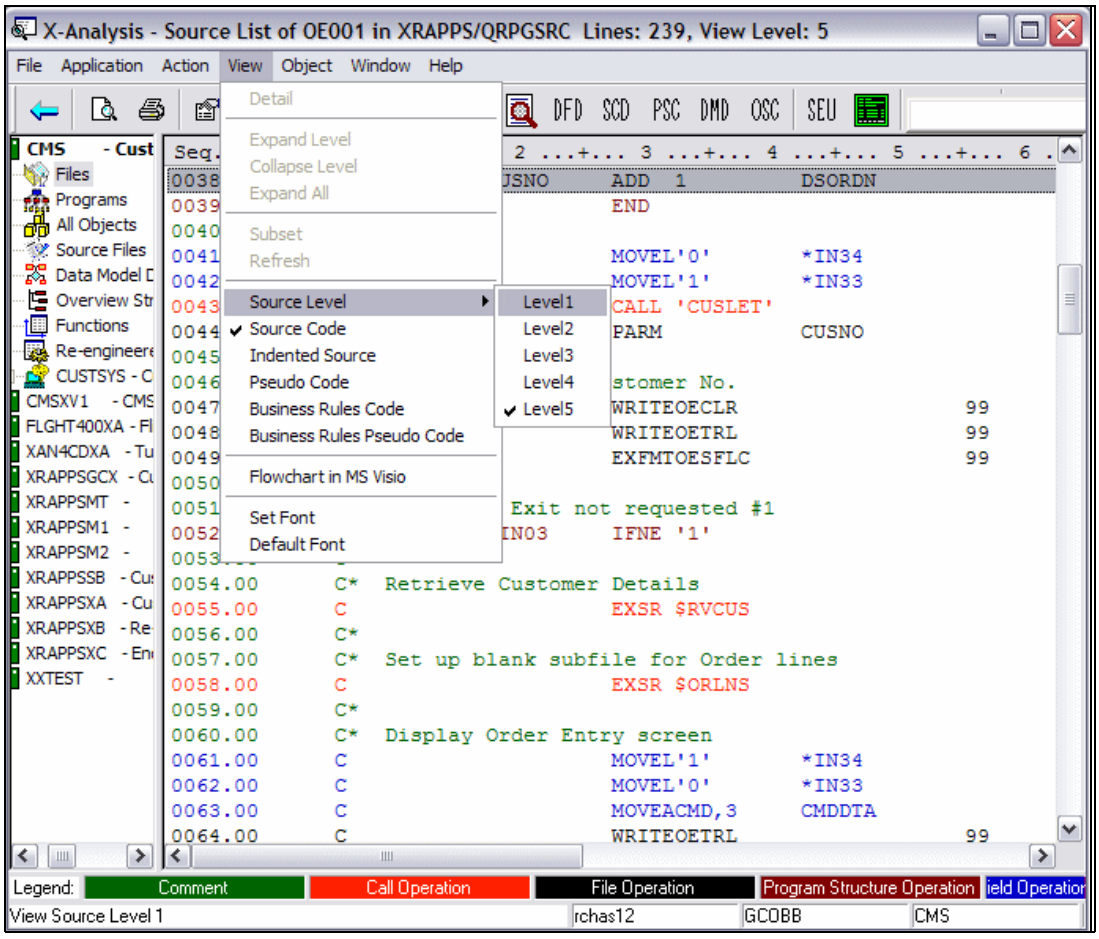

Figure 4-42 Source levels on Source browser

3. The source list for OE001 is reduced to the absolute minimum. Only the subroutines and comments are displayed (Figure 4-43).

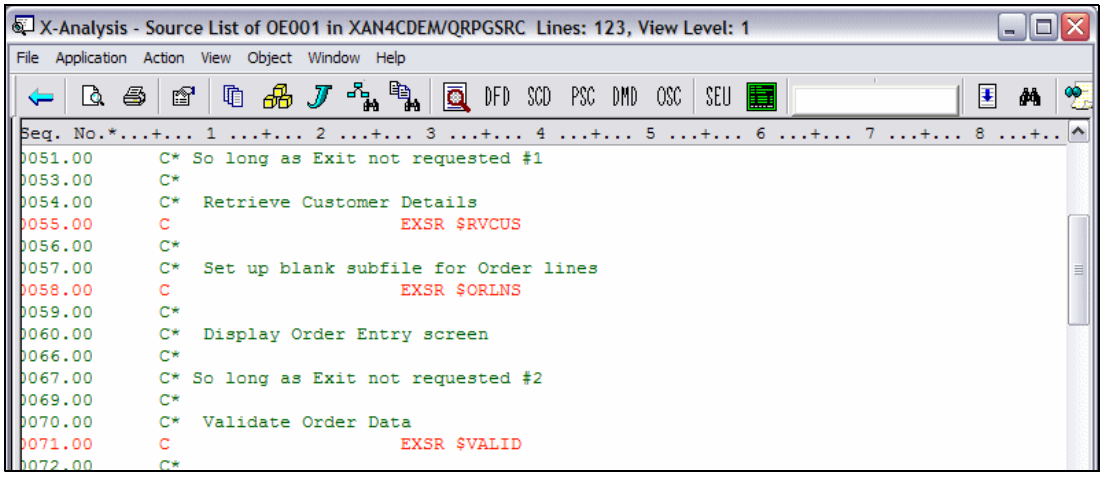
X-Analysis - Source List of OE001 in XAN4CDEM/QRPGSRC Lines: 123, View Level: 1
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
0051.00 C* So long as Exit not requested #1
0053.00 C*
0054.00 C* Retrieve Customer Details
0055.00 C EXSR $RVCUS
0056.00 C*
0057.00 C* Set up blank subfile for Order lines
0058.00 C EXSR $ORLNS
0059.00 C*
0060.00 C* Display Order Entry screen
0066.00 C*
0067.00 C* So long as Exit not requested #2
0069.00 C*
0070.00 C* Validate Order Data
0071.00 C EXSR $VALID

Figure 4-43 OE001 Source list - View level 1

4. Incrementally increase the source level from 1 to 5 to see the number of source lines increase. Selecting **View** → **Source Level** → **Level 5** returns you to normal source listing.

4.4.5 Indented Source

The indented source view presents the source listing in an indented format. Source lines within all conditional or flow of control statements such as IF/ELSE/END and DO/WHILE are shown indented. The indented source view improves code readability and helps you comprehend the program logic. This view is especially helpful when viewing Original Program Model (OPM) RPG program source file listings due to the columnar format restrictions of these programs.

To display the indented source view, complete the following steps:

1. In the source listing for OE001 make sure you are at View Level 5. From the toolbar menu, select **View** → **Indented Source**. The Indented Source view for OE001 opens (Figure 4-44).

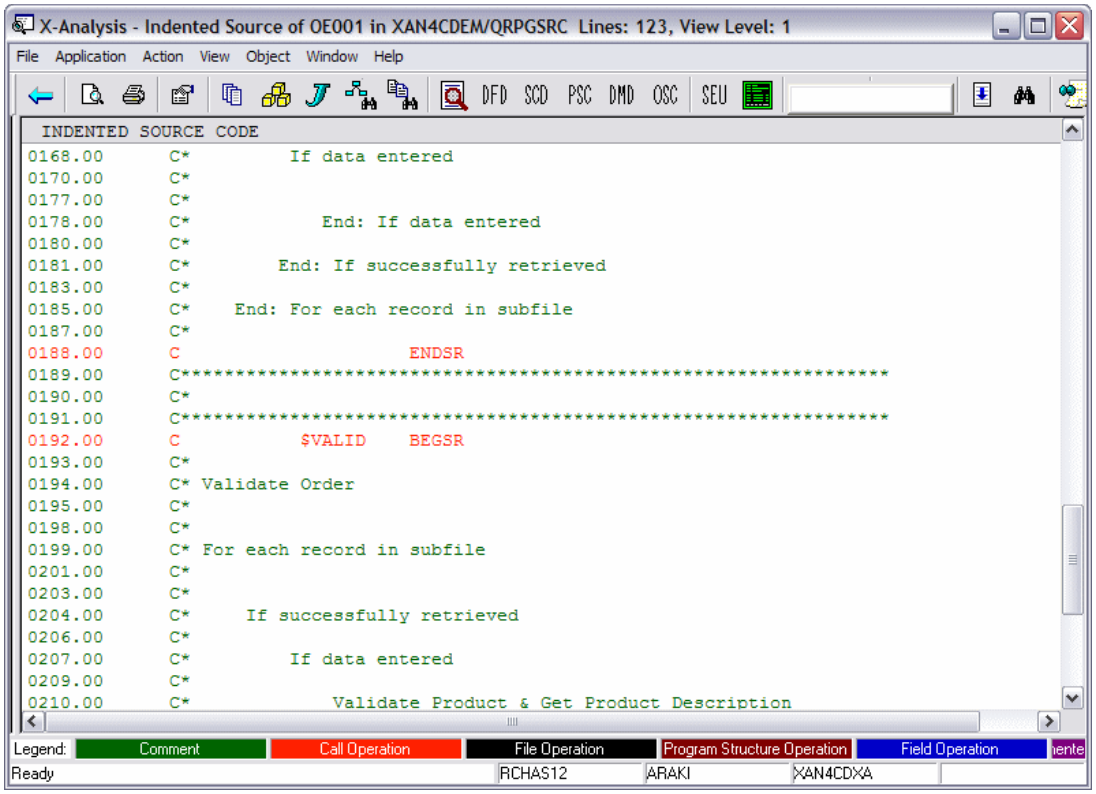

Figure 4-44 OE001 Indented source view

2. Select **View** → **Source Code** to return to normal source listing.

4.4.6 Pseudo Code Displays

In the Pseudo Code view, the source lines are displayed as English statements. Java and other non-RPG programmers may find this view the most helpful to read and aid in understanding the program logic.

To display Pseudo Code view for OE001, complete the following steps:

1. In the source listing for OE001 make sure you are at View Level 5. From the toolbar menu, select **View** → **Pseudo Code**. The Pseudo Code view for OE001 opens (Figure 4-45).

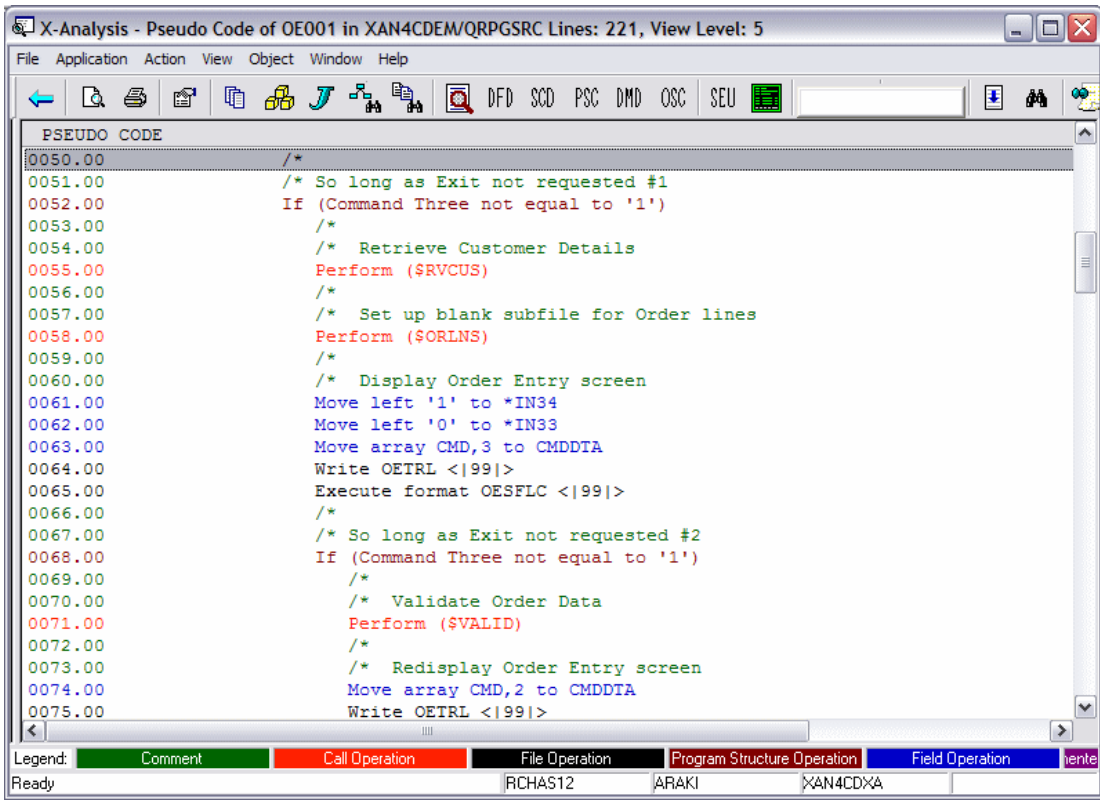
X-Analysis - Pseudo Code of OE001 in XAN4CDEM/QRPGSRC Lines: 221, View Level: 5
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
PSEUDO CODE
0050.00 /*
0051.00 /* So long as Exit not requested #1
0052.00 If (Command Three not equal to '1')
0053.00 /*
0054.00 /* Retrieve Customer Details
0055.00 Perform ($RVCUS)
0056.00 /*
0057.00 /* Set up blank subfile for Order lines
0058.00 Perform ($ORLNS)
0059.00 /*
0060.00 /* Display Order Entry screen
0061.00 Move left '1' to *IN34
0062.00 Move left '0' to *IN33
0063.00 Move array CMD,3 to CMDDTA
0064.00 Write OETRL <|99|>
0065.00 Execute format OESFLC <|99|>
0066.00 /*
0067.00 /* So long as Exit not requested #2
0068.00 If (Command Three not equal to '1')
0069.00 /*
0070.00 /* Validate Order Data
0071.00 Perform ($VALID)
0072.00 /*
0073.00 /* Redisplay Order Entry screen
0074.00 Move array CMD,2 to CMDDTA
0075.00 Write OETRL <|99|>
Legend: Comment Call Operation File Operation Program Structure Operation Field Operation
Ready
RCHAS12
ARAKI
XAN4CDXA

Figure 4-45 OE001 Pseudo Code view

2. Select **View** → **Source Code** to return to normal source listing.

4.4.7 Program flowcharts

Program Structure Chart (PSC) graphically displays the sequence of calls in a program. The call could be to execute subroutines, programs, modules, or procedures in service programs. The item circled in Figure 4-46 represents a subroutine. Subroutines are depicted by small gray rectangles containing the name of the subroutine.

To display the Program Structure Chart for program OE001, complete the following steps.

1. In the source listing for OE001, click the Program Structure Chart button PSC.
2. From the toolbar menu, select **Object** → **Program Structure Chart**.

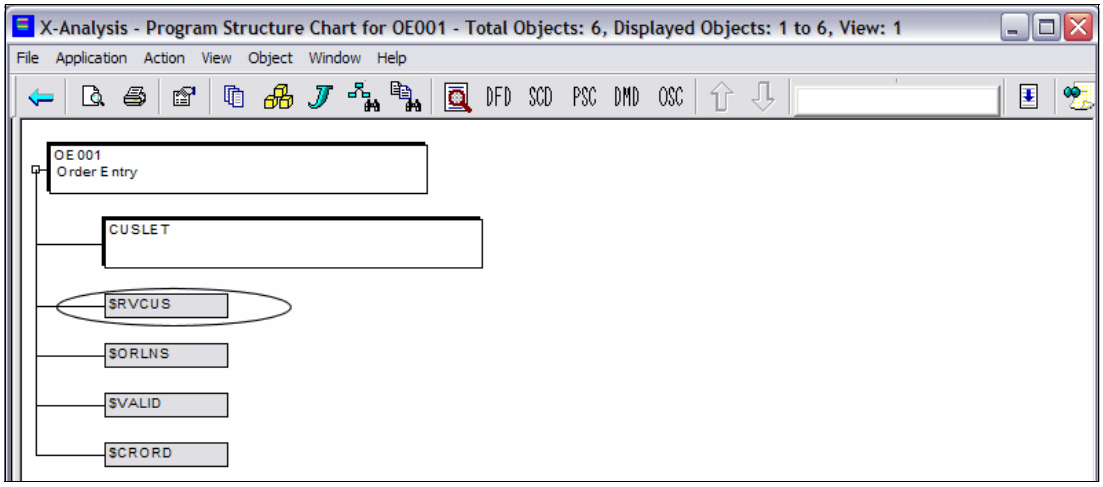

Figure 4-46 Program Structure Chart

All other items (modules, procedures, and service programs), are the same size as the program element for OE001. The function type determines the background color for these items (refer to Figure 4-23 on page 127 for the color-coded Structure Chart legend).

3. Double-click the $RVCUS subroutine in the Program Structure Chart. The Source List of OE001 with the line EXSR $RVCUS highlighted is displayed (Figure 4-47).

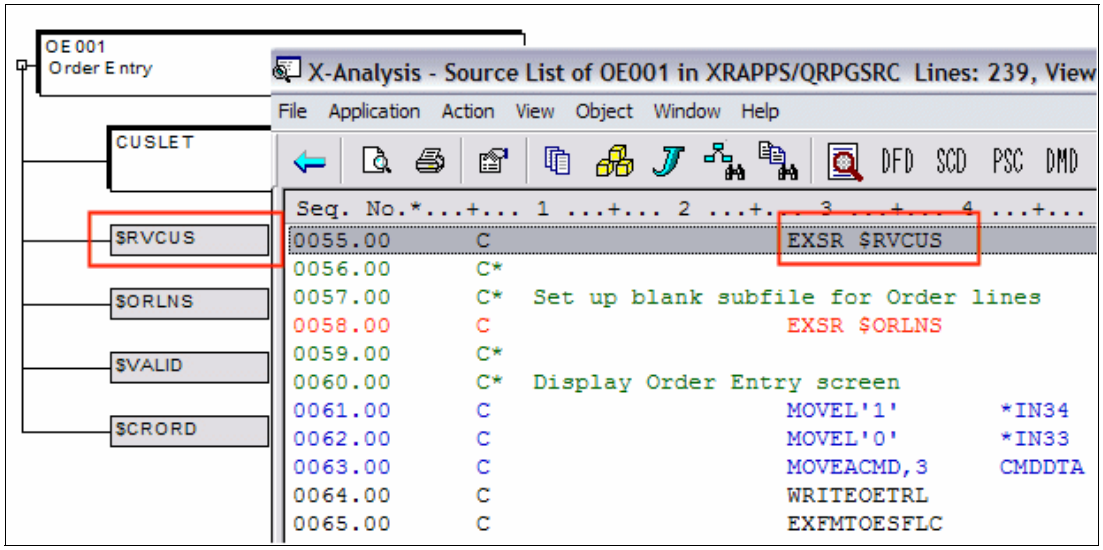

Figure 4-47 Zoom to $RVCUS subroutine from OE001 Program Structure Chart

4.4.8 Microsoft Visio flow charts

X-Analysis has the ability to generate a flow chart of the program using Microsoft Visio. This option is available only in the Source Browser view and can be performed only for OPM RPG and ILE RPG programs.

To generate a Visio flow chart for program OE001, complete the following steps:

1. In the source listing for OE001, select **View** → **Flowchart in MS Visio**. Microsoft Visio opens showing a flow chart of OE001 (Figure 4-48).

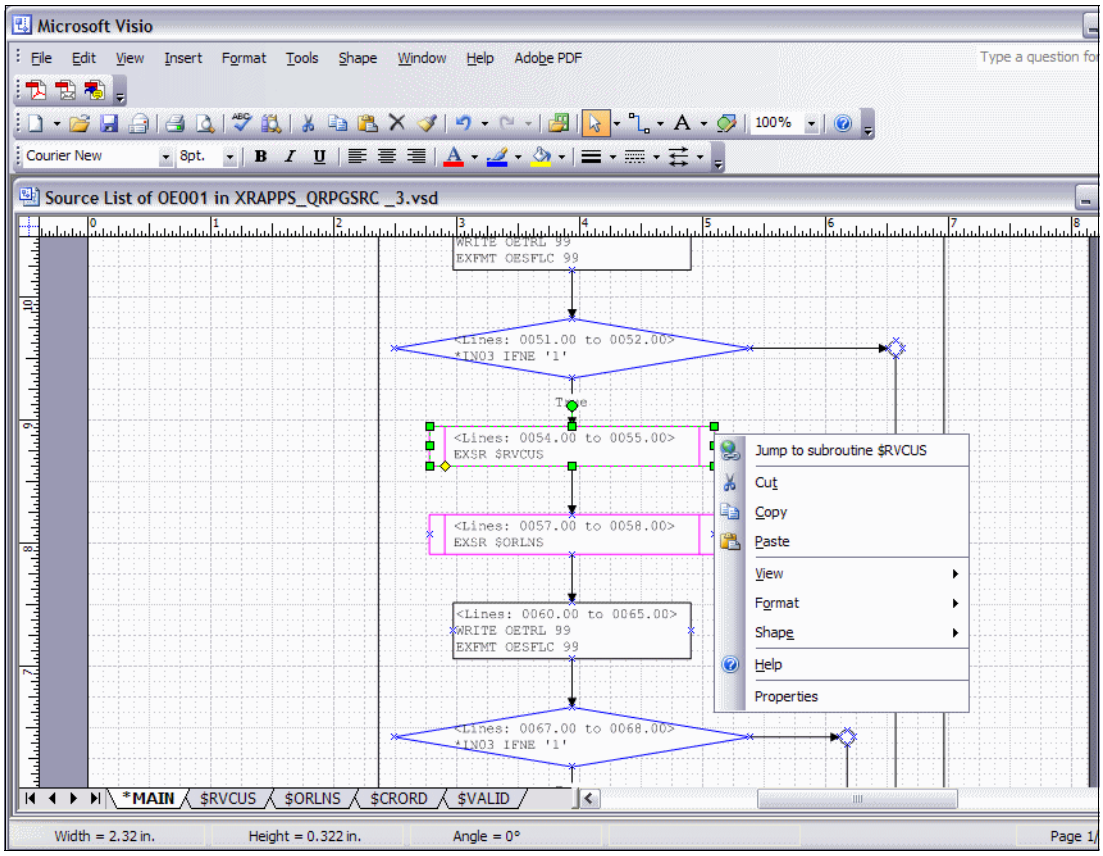

Figure 4-48 Flowchart of OE001 generated using Visio

4.4.9 Business rules

The Business Rules view enables you to see the business rule logic highlighted within the member. You can immediately see the business logic within the context of the program as a whole.

Business rules are generated automatically by the reverse-engineering operations described in 3.8, “Running the X-Analysis MVC re-engineering process” on page 60. During this process, the program source is grouped into discreet blocks of logic so that each block represents a particular execution of a business rule. Blocks of code are then converted to pseudo code that describes the execution of the logic. Literals and constants, used where possible in the narration, produce very accurate descriptions of the logic. Each rule has a unique identifier that makes systemwide analysis and documentation of business rules possible in X-Analysis.

The Business Rules view is enabled only for the OPM RPG and ILE RPG programs. It can be selected from all source views (Normal, Indented, Pseudo Code).

Note: Business Rules Code and Business Rules Pseudo Code highlight the major file operations in the program, along with related comments.

The program OE001 is not a good example for this exercise because it does not contain any business rules. To showcase the features of this Business Rules view, we use the program CUSFMAINT instead.

To view the business logic for CUSFMAINT, complete the following steps:

1. On left side of the X-Analysis development environment, double-click **Programs** under the Application tree for CMS.
2. At the Work with Objects window (Figure 4-49), click **OK**.

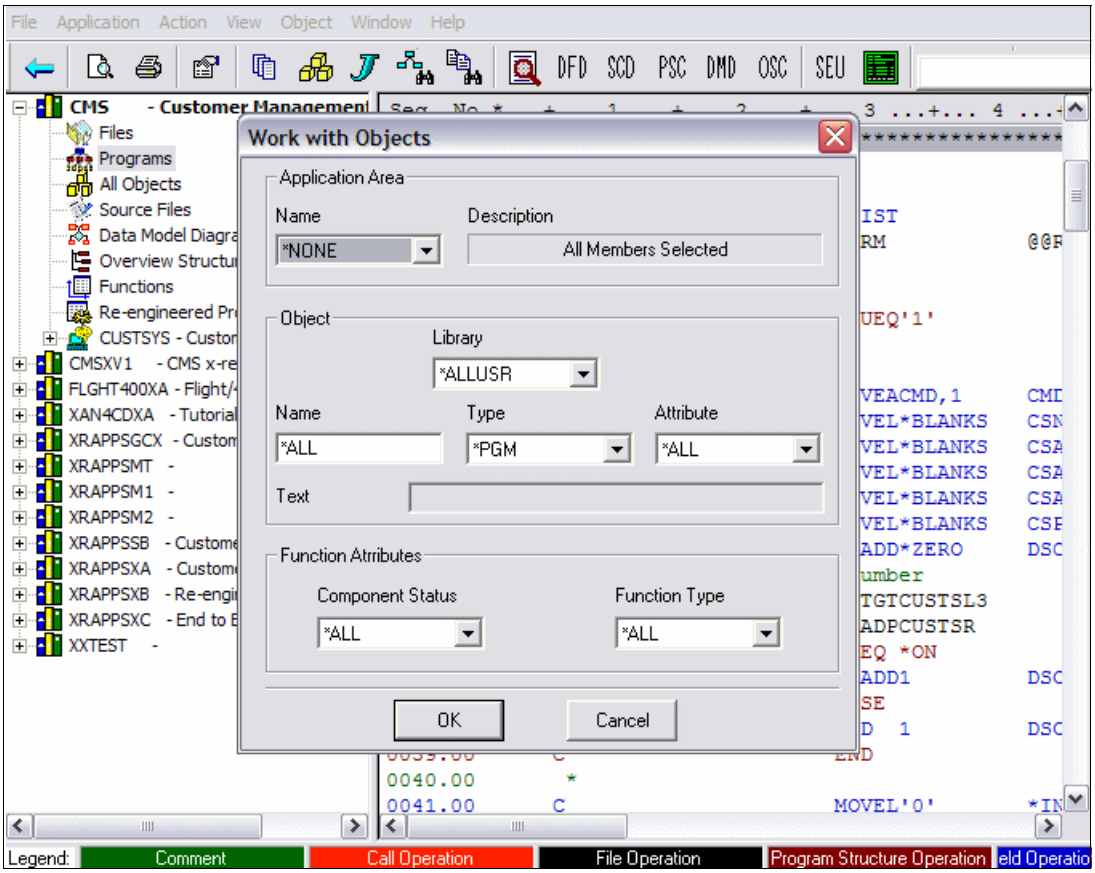

Figure 4-49 Work with Objects window

3. A list of all programs in the library appears in the right pane of the window. Double-click **CUSFMAINT** (Figure 4-50).

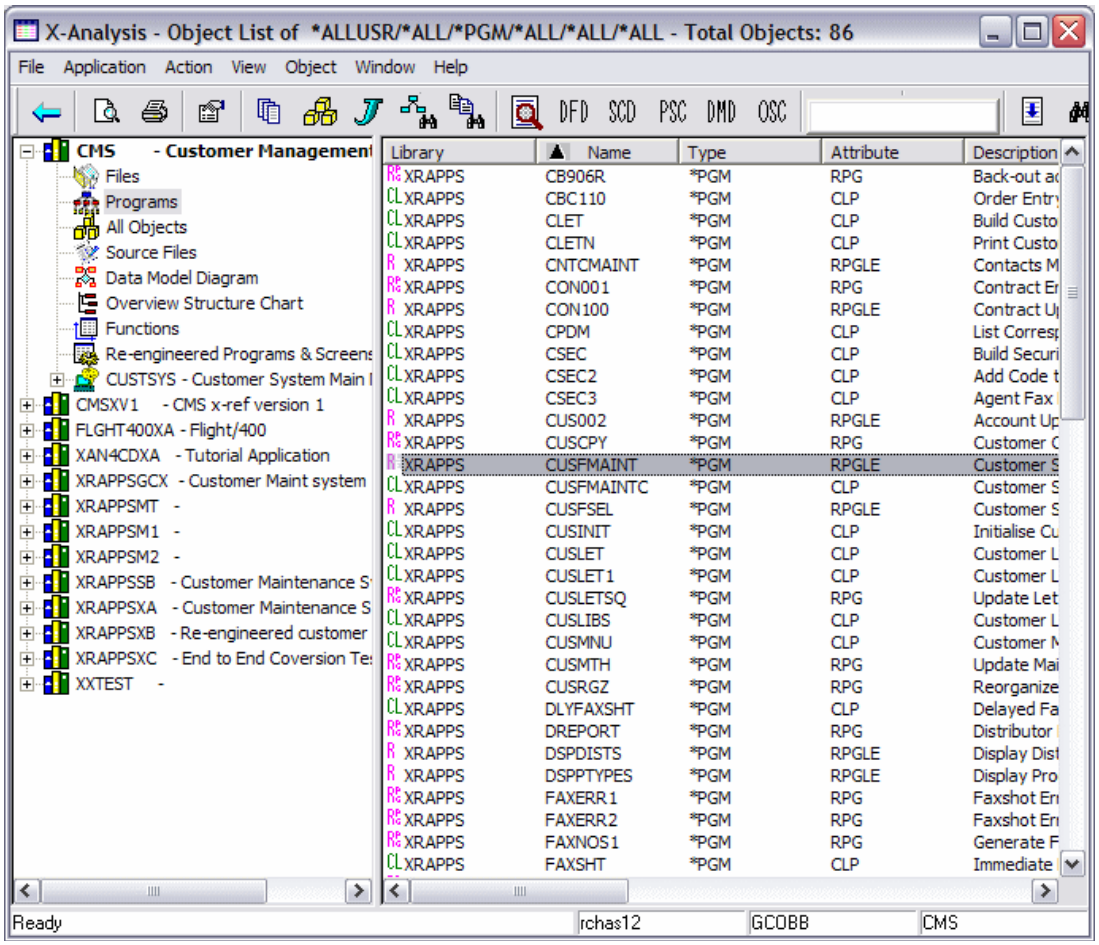
X-Analysis - Object List of *ALLUSR/*ALL/*PGM/*ALL/*ALL/*ALL - Total Objects: 86
File Application Action View Object Window Help
DFD SCD PSC DMD OSC
CMS - Customer Management
Files
Programs
All Objects
Source Files
Data Model Diagram
Overview Structure Chart
Functions
Re-engineered Programs & Screens
CUSTSYS - Customer System Main
CMSXV1 - CMS x-ref version 1
FLGHT400XA - Flight/400
XAN4CDXA - Tutorial Application
XRAPPSGCX - Customer Maint system
XRAPPSMT -
XRAPPSM1 -
XRAPPSM2 -
XRAPPSSB - Customer Maintenance S
XRAPPSXA - Customer Maintenance S
XRAPPSXB - Re-engineered customer
XRAPPSXC - End to End Coversion Te
XXTEST -
Library Name Type Attribute Description
XRAPPS CB906R *PGM RPG Back-out a
XRAPPS CBC110 *PGM CLP Order Entry
XRAPPS CLET *PGM CLP Build Custo
XRAPPS CLETN *PGM CLP Print Custo
XRAPPS CNTCMAINT *PGM RPGLE Contacts M
XRAPPS CON001 *PGM RPG Contract Er
XRAPPS CON100 *PGM RPGLE Contract Up
XRAPPS CPDM *PGM CLP List Corresp
XRAPPS CSEC *PGM CLP Build Securi
XRAPPS CSEC2 *PGM CLP Add Code t
XRAPPS CSEC3 *PGM CLP Agent Fax
XRAPPS CUS002 *PGM RPGLE Account Up
XRAPPS CUSCPY *PGM RPG Customer C
XRAPPS CUSFMAINT *PGM RPGLE Customer S
XRAPPS CUSFMAINTC *PGM CLP Customer S
XRAPPS CUSFSEL *PGM RPGLE Customer S
XRAPPS CUSINIT *PGM CLP Initialise Cu
XRAPPS CUSLET *PGM CLP Customer L
XRAPPS CUSLET1 *PGM CLP Customer L
XRAPPS CUSLETSQ *PGM RPG Update Let
XRAPPS CUSLIBS *PGM CLP Customer L
XRAPPS CUSMNU *PGM CLP Customer M
XRAPPS CUSMTH *PGM RPG Update Mai
XRAPPS CUSRGZ *PGM RPG Reorganize
XRAPPS DLYFAXSHT *PGM CLP Delayed Fa
XRAPPS DREPORT *PGM RPG Distributor
XRAPPS DSPDISTS *PGM RPGLE Display Dist
XRAPPS DSPPTYPES *PGM RPGLE Display Pro
XRAPPS FAXERR1 *PGM RPG Faxshot Er
XRAPPS FAXERR2 *PGM RPG Faxshot Er
XRAPPS FAXNOS1 *PGM RPG Generate F
XRAPPS FAXSHT *PGM CLP Immediate
Ready
rchas12
GCOBB
CMS

Figure 4-50 Select CUSFMAINT

4. The source listing for CUSFMAINT opens. From the toolbar menu, select **View** → **Business Rules Code**. The Business Rules Code of CUSFMAINT screen opens (Figure 4-51).

> **Note:** An error message, `No Business Rules have been derived yet`, is displayed if Business Rules have not been set for the application.
>
> An information message, `No business rule have been created for source member XYZ`, is displayed if Business Rules have been set for the application but have not been generated for the specific member.

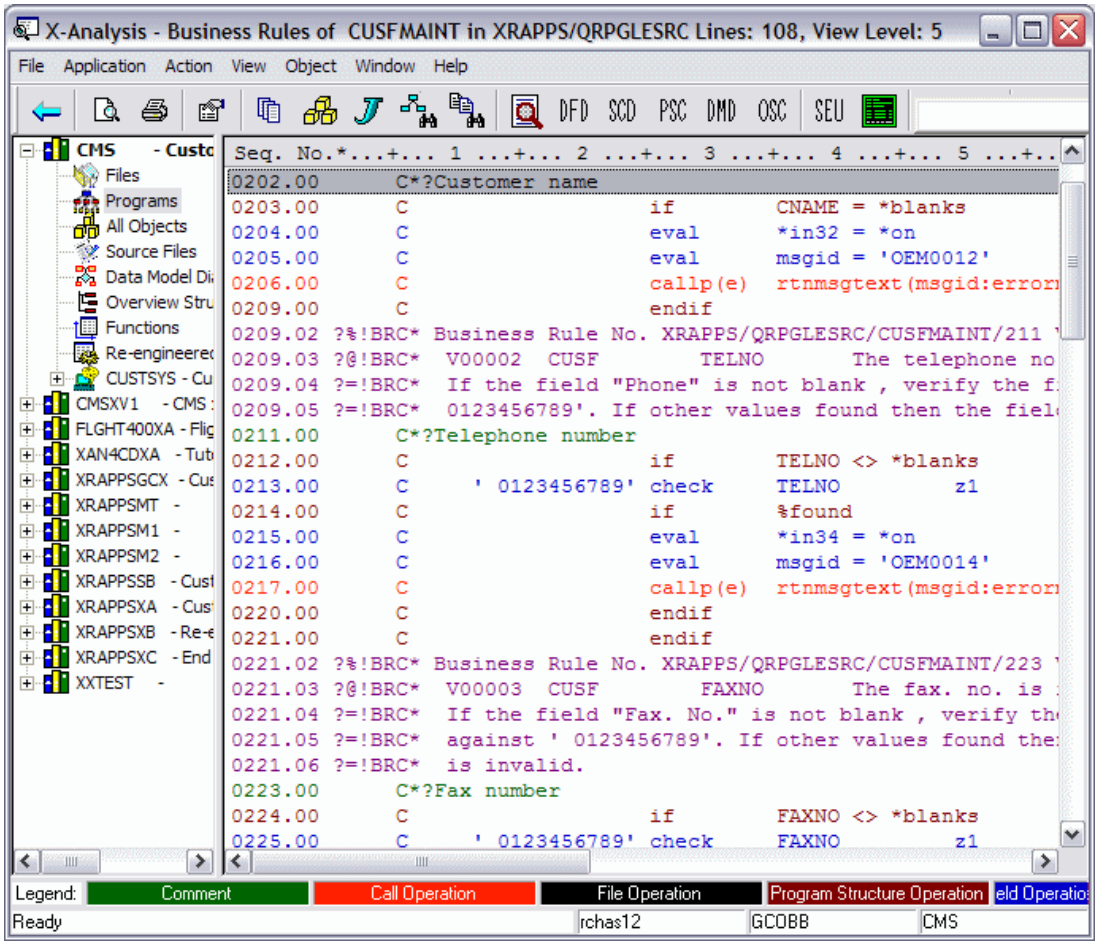
X-Analysis - Business Rules of CUSFMAINT in XRAPPS/QRPGLESRC Lines: 108, View Level: 5
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
CMS - Custo
Files
Programs
All Objects
Source Files
Data Model Di
Overview Stru
Functions
Re-engineere
CUSTSYS - Cu
CMSXV1 - CMS
FLGHT400XA - Flig
XAN4CDXA - Tut
XRAPPSGCX - Cus
XRAPPSMT -
XRAPPSM1 -
XRAPPSM2 -
XRAPPSSB - Cust
XRAPPSXA - Cus
XRAPPSXB - Re-e
XRAPPSXC - End
XXTEST -
Seq. No.*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+..
0202.00 C*?Customer name
0203.00 C if CNAME = *blanks
0204.00 C eval *in32 = *on
0205.00 C eval msgid = 'OEM0012'
0206.00 C callp(e) rtnmsgtext(msgid:error
0209.00 C endif
0209.02 ?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/211
0209.03 ?@!BRC* V00002 CUSF TELNO The telephone no
0209.04 ?=!BRC* If the field "Phone" is not blank , verify the f
0209.05 ?=!BRC* 0123456789'. If other values found then the fiel
0211.00 C*?Telephone number
0212.00 C if TELNO <> *blanks
0213.00 C ' 0123456789' check TELNO z1
0214.00 C if %found
0215.00 C eval *in34 = *on
0216.00 C eval msgid = 'OEM0014'
0217.00 C callp(e) rtnmsgtext(msgid:error
0220.00 C endif
0221.00 C endif
0221.02 ?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/223
0221.03 ?@!BRC* V00003 CUSF FAXNO The fax. no. is
0221.04 ?=!BRC* If the field "Fax. No." is not blank , verify th
0221.05 ?=!BRC* against ' 0123456789'. If other values found the
0221.06 ?=!BRC* is invalid.
0223.00 C*?Fax number
0224.00 C if FAXNO <> *blanks
0225.00 C ' 0123456789' check FAXNO z1
Legend: Comment Call Operation File Operation Program Structure Operation
Ready
rchas12
GCOBB
CMS

Figure 4-51 Business rules view for CUSFMAINT

5. To look at the business rules Pseudo Code view of this program, from the toolbar menu select **View** → **Business Rules Pseudo Code**. The Business Rules Pseudo Code display for CUSFMAINT opens (Figure 4-52).

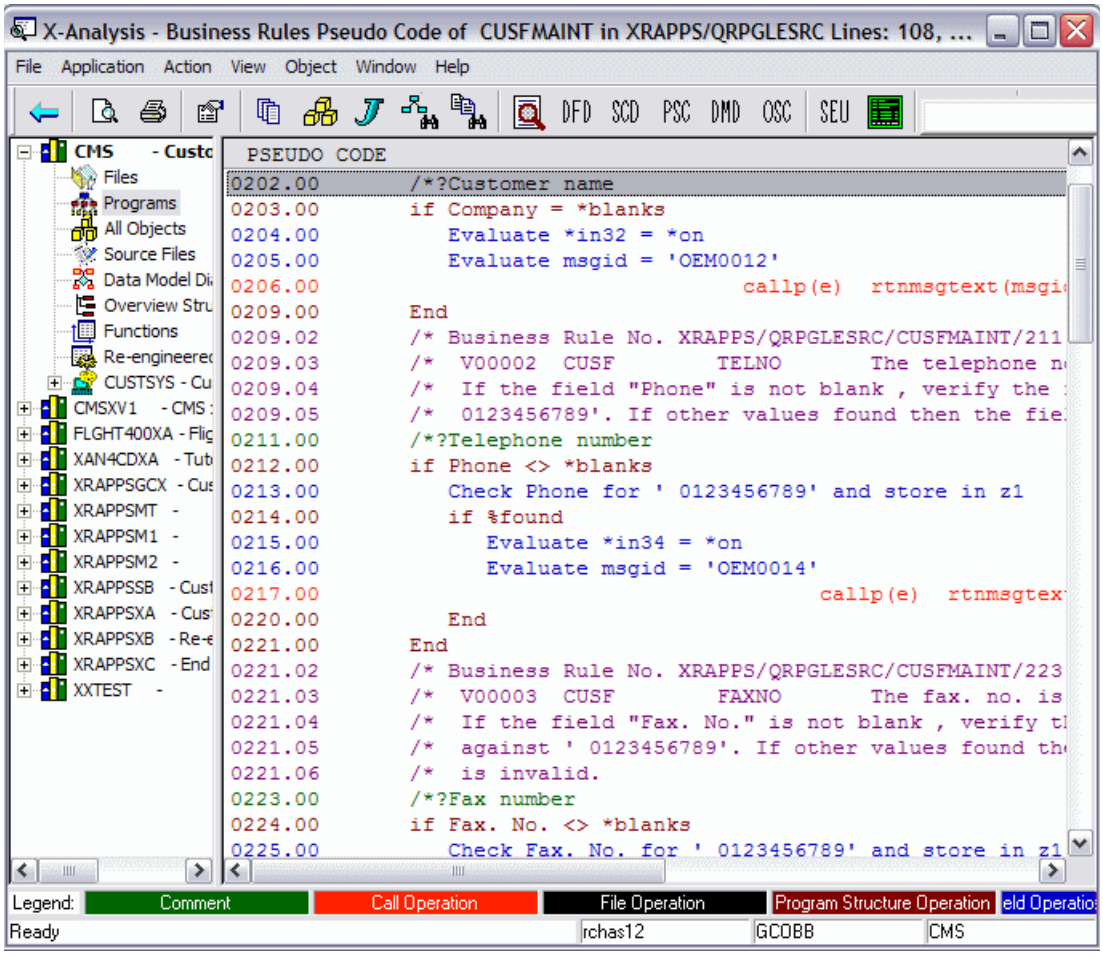
X-Analysis - Business Rules Pseudo Code of CUSFMAINT in XRAPPS/QRPGLESRC Lines: 108, ...
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
PSEUDO CODE
0202.00 /*?Customer name
0203.00 if Company = *blanks
0204.00 Evaluate *in32 = *on
0205.00 Evaluate msgid = 'OEM0012'
0206.00 callp(e) rtnmsgtext(msgi
0209.00 End
0209.02 /* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/211
0209.03 /* V00002 CUSF TELNO The telephone n
0209.04 /* If the field "Phone" is not blank , verify the
0209.05 /* 0123456789'. If other values found then the fie
0211.00 /*?Telephone number
0212.00 if Phone <> *blanks
0213.00 Check Phone for ' 0123456789' and store in z1
0214.00 if %found
0215.00 Evaluate *in34 = *on
0216.00 Evaluate msgid = 'OEM0014'
0217.00 callp(e) rtnmsgtex
0220.00 End
0221.00 End
0221.02 /* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/223
0221.03 /* V00003 CUSF FAXNO The fax. no. is
0221.04 /* If the field "Fax. No." is not blank , verify t
0221.05 /* against ' 0123456789'. If other values found th
0221.06 /* is invalid.
0223.00 /*?Fax number
0224.00 if Fax. No. <> *blanks
0225.00 Check Fax. No. for ' 0123456789' and store in z1
CMS - Custo
Files
Programs
All Objects
Source Files
Data Model Di
Overview Stru
Functions
Re-engineerec
CUSTSYS - Cu
CMSXV1 - CMS
FLGHT400XA - Flig
XAN4CDXA - Tut
XRAPPSGCX - Cus
XRAPPSMT -
XRAPPSM1 -
XRAPPSM2 -
XRAPPSSB - Cust
XRAPPSXA - Cus
XRAPPSXB - Re-e
XRAPPSXC - End
XXTEST -
Legend: Comment Call Operation File Operation Program Structure Operation eld Operatio
Ready rchas12 GCOBB CMS

Figure 4-52 Business rules Pseudo Code view for CUSFMAINT

4.5 Using X-Analysis cross-reference repository for modernizing

This section provides a detailed description of the X-Analysis cross-reference repository and shows how it can be used to aid in application modernization activities. The objective is to provide information so you can use the data in the repository for your own specific modernization requirements. When you understand the format, architecture, and content of the database, you can determine whether developing custom programs to automate application modernization changes is appropriate.

4.5.1 X-Analysis cross-reference repository details

As described earlier, X-Analysis builds a cross-reference repository of every line of source code in the existing application. This repository is then completely cross-indexed and analyzed, enabling any cross-reference query to run instantly. Much of the information stored in the cross-reference repository can be used in modernization activities (for example, making

existing RPG applications more maintainable or converting existing applications into reusable components). The following list provides some specific modernization activities that the X-Analysis cross-reference repository could be used for:

- Using prototypes for program calls
- Converting subroutines to procedures
- Using reusable database I/O routines
- Removing indicator usage
- Removing usage of program defined files
- Placing definitions in D-Specs at the start of programs
- Eliminating GOTO and CAB operations

In this section, we focus on two of the tables in the X-Analysis cross-reference repository, X@XPGRF and XAGWU. (The subsequent section gives details about format and usage of these tables.) A sample utility program that demonstrates how you can use the data in the cross-reference repository to perform a specific application modernization task is provided. The X-Analysis cross-reference repository is comprised of many tables, which are documented in detail in Appendix B, "X-Analysis cross-reference repository details" on page 257.

Table X@XPGRF program object references

X@XPGRF contains objects referenced by programs, commands, and menus. These references are retrieved primarily from object data. However, the source is also interpreted for additional references. There are two equivalent files:

- XVXPGREF for variant libraries
- XPROCREF for OCL

X@XPGRF and its equivalents are used to:

- Provide comprehensive Object Where Used data.
- Enable complete investigation of program references.

Table 4-1 X@XPGRF file layout

Field	Datatype	Length	Description
WHPNAM	CHAR	10	The name of the program, CMD or MENU
WHTEXT	CHAR	50	The text held against WHPNAM
WHFNAM	CHAR	11	The name of the referenced object
WHOBTP	CHAR	1	The type of referenced object: P - Program F - File D - Data area C - Command
WUSAGE	CHAR	1	The object type usage: I - Input file U - Update or input file O - Output file A - Input and output file B - Input, output, and update file C - Command calls command processing program V - Command calls validity checking program I - Program calls program or calls command T - Trigger program input file S - Trigger program update file

Note: The object type of the WHPNAM field may be implied by the value of the WUSAGE. This is important when an object such as a program and a command have the same name. When WUSAGE = C or V, the WHPNAM object type is command, otherwise the WHPNAM object type is a program.

Table XAGWU X-Analysis Where Used data

XAGWU (X-Analysis Where Used data) is an index of each significant word in each source member with an allowable source type. The source member details are stored (library, file, member, type, relative record number (RRN)) together with the variable name, type, and whether modified. When used with alias and rename data this allows instant cross-reference of any variable, constant, or such against the entire application.

To retrieve an occurrence of a variable, use the source member details to open the source file member, then use the RRN to retrieve the individual source record. Use a standard procedure to interpret the source line. The source file attribute (VATTR) determines which standard procedure is used to interpret the source. For COBOL, the field sequence no. (VVARSQ) allows determination of the specific occurrence of the field in the statement. Where statements extend over several source lines, standard procedures are used to build the complete statements, reading both backward and forward through the source member.

Table 4-2 XAGWU file layout

Field	Datatype	Length	Description
VSRCLB	CHAR	10	Source library
VSRCFL	CHAR	10	Source file
VSRCMB	CHAR	10	Source member
VOBTY	CHAR	2	Variable type: AA - Start of program logic section CL - Called program CN - Constant/literal EF - Externally defined data structure IN - Indicator PI - Procedure interface definition SR - Start of ILE RPG subroutine, COBOL section, or paragraph
VRECN	PACKED	5,0	RRN where the variable occurs in the source member
VMOD	CHAR	1	Indicates, if relevant, whether the variable is modified
VATTR	CHAR	2	Indicates the source member attribute: CL - CL variant (CLP, CL, CLLE) RG - RPG variant (RPG, RPG38, SQLRPG) RI - RPGLE variant (RPGLE, SQLRPGLE) CB - COBOL variant (CBL) PF - PF variant LF - LF variant DS - DSPF variant PR - PRTF variant OC - OCL SQ - SQL US - User space AL - Alias-only record (enables retrieval of references to a variable when it occurs only as an alias in a source member)

Field	Datatype	Length	Description
VVARSQ	PACKED	5,0	The sequence number (position) of the variable within the source statement (or the part of it that is on the source line if the statement extends over more than one line). This only applies to COBOL and free-format ILE RPG.

4.5.2 Using the repository: an example program

The sample utility program XREFEXAMPL, demonstrates how you can use the information provided in the X-Analysis cross-reference repository. This is an SQLRPGLE program that uses Structured Query Language (SQL) access methods to search the repository files for program references to a specified program (passed in as an input parameter). The utility program performs the following actions:

- If the specified program is referenced by the use of a dynamic, unbound call (operation code CALL), the utility replaces it with a prototyped call (operation code CALLP).
- It converts the CALL parameter list format to the CALLP parameter format, generates the prototype in a separate member, and inserts a copybook statement to that prototype member.
- All changes described are applied to a new source file member (leaving the original source file member intact and unchanged). The new source file member has the same name as the original, but the first character is replaced with Z. (If the name of the original member is OE001, the new member containing the changes would be named ZE001.)

You may be wondering why we chose to highlight this particular modification in the example program and what it has to do with application modernization. Prototyped calls have several advantages over non-prototyped calls:

- The compiler can check whether the correct types and lengths of parameters are used.
- When prototyped, a program call can be easily changed to a procedure call by simply changing the prototype from EXTPGM to EXTPROC.
- The CONST keyword can be used on a parameter definition of a prototyped call to indicate that a constant value is being passed.

The following sample utility program is coded to handle certain cases and coding styles. If you decide to use it, examine it carefully and make changes to tailor it to your environment. The program in its current form makes the following assumptions:

- The programs being searched in the cross-reference repository are ILE RPG programs.
- The source file containing members to examine and change is named QRPGLESRC.
- The parameter lists of all dynamic calls are specified on the lines following the CALL operation code, using the PARM operation. No dynamic calls are using the name PLIST. In addition, the parameter variables are defined on the same line as the PARM operation code.
- Member names do not start with the letter Z because new members are generated and named by copying the name of the original member and replacing the first character with the letter Z.

For instructions about how to download this sample program, refer to “Restoring the xrefexampl.savf library” on page 268.

Example 4-1 Example program to convert dynamic calls to prototyped calls

```
hDftActGrp(*NO)
     hoption(*srcstmt : *nodebugio)
// Program: XREF_EXP
      //   X-Analysis X-Ref Database Example Program.
      //   This sample utility pgm provides an example of how one can use
      //   the information stored in the X-Analysis X-Ref Database.
      //   In this example utility pgm, a program name and source file
      //   library are accepted as input parameters. The X-Ref database
      //   is then searched to find all other programs that make dynamic,
      //   non-bound calls to the specified program. If any are found, this
      //   utility creates a copy of the program's source member and replaces
      //   all instances of dynamic calls (operation code 'CALL') with
      //   prototyped calls (operation code 'CALLP'). The parameter list of
      //   the dynamic call is also converted to callp parameter
      //   format. Finally, a prototype is generated in a seperate
      //   member and a copybook with that prototype is inserted.
      // To create this program:
      //   CRTSQLRPGI OBJ(OBJLIB/XREFEXAMPL)
      //     SRCFILE(SRCLIB/QRPGLESRC) COMMIT(*NONE)
      // To run:
      //   1- Add both cross-reference library and source file library
      //      to your library list
      //   2- CALL PGM(XREFEXAMPL/XREFEXAMPL) PARM(yourPgmName yourSrcFilLib)

      //  ----------------------------------------------------------------
      //   Global variables, data structures, constants
      //  ----------------------------------------------------------------
     d pgmRefRow     e ds                  extname(x@xpgrf)
     d gwuRow        e ds                  extname(xagwu)
     d rpgleRow      e ds                  extname(qrpglesrc)
     d protoRow      e ds                  extname(qrpglesrc) prefix(pr_)
     d insertRow     e ds                  extname(qrpglesrc) prefix(i_)
     d srcMbrRow       ds
     d  srcStm                             like(srcdta)
     d  srcRRN                       15p 0
      // Input parameters
     d inPgmNam        s             10a
     d inSrcLibNam     s             10a
      // Constants
     d upper           c                   'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
     d lower           c                   'abcdefghijklmnopqrstuvwxyz'

     d procCall        s             35a
     d parmNam         s             10a
     d parmCount       s              3s 0
     d parmArray       s             10a   dim(100)
     d parmLenArr      s              5a   dim(100)
     d parmDecLenArr   s              2a   dim(100)
     d pc              s              3s 0
     d newMbrNam       s             10a
     d srcStmUC        s                   like(srcdta)
     d newLine         s                   like(srcdta)
     d nxtRRN          s                   like(vrecn)
     d specCode        s              1a
     d ovrdbfFlag      s              1a
     d insCBkFlag      s              1a
     d genProFlag      s              1a
     d qcmd            s            120a
      //  ----------------------------------------------------------------
```

```
 //   Prototypes
 //  ----------------------------------------------------------------
d qcmdexc         pr                  extpgm('QCMDEXC')
d   cmd                         3000a   options(*varsize) const
d   cmdlen                        15p 5 const
d                                  3a   const options(*nopass)
 //  ----------------------------------------------------------------
 //  - Parameter lists                                              -
 //  ----------------------------------------------------------------
c     *entry        plist
c                   parm                    inPgmNam
c                   parm                    inSrcLibNam
 //  ----------------------------------------------------------------
 //  - Main procedure                                               -
 //  ----------------------------------------------------------------
 // Find all program references
 /FREE
  genProFlag = '0';
  exsr findPgmRef;
  // Generate the prototype for the callp
  if genProFlag = '1';
    exsr genPrototype;
  endif;
  *inlr = *on;
  return;
  //  ----------------------------------------------------------------
  begsr findPgmRef;
    // Find all program references to specified program by searching
    // the X-Ref Pgm Ref file X@XPGRF
    //  ----------------------------------------------------------------
 /END-FREE

C/EXEC SQL
C+ declare csr_X@xpgrf CURSOR FOR
C+ select *
C+ from x@xpgrf
C+ where whfnam = :inPgmNam
C/END-EXEC
C/EXEC SQL
C+   open csr_X@xpgrf
C/END-EXEC SQL

 /FREE
    // If any references to program were found, find where it was used
  dou sqlstt <> '00000';
 /END-FREE

C/EXEC SQL
C+   fetch csr_X@xpgrf into :pgmRefRow
C/END-EXEC

 /FREE
    if sqlstt = '00000';
      exsr findWhereUsed;
    endif;
  enddo;
 /END-FREE

C/EXEC SQL
C+   close csr_X@xpgrf
```

```
C/END-EXEC SQL

 /FREE
  endsr;
   //---------------------------------------------------------------
  begsr findWhereUsed;
    // Find where the reference pgm is used.
   //---------------------------------------------------------------
  ovrdbfFlag = '0';
 /END-FREE

C/EXEC SQL
C+ declare csr_xagwu CURSOR FOR
C+ select *
C+ from xagwu
C+ where vsrcfl = 'QRPGLESRC'
c+   and vsrcmb = :whpnam
c+   and vname = :whfnam
C/END-EXEC
C/EXEC SQL
C+   open csr_xagwu
C/END-EXEC SQL

 /FREE
  dou sqlstt <> '00000';
 /END-FREE

C/EXEC SQL
C+   fetch csr_xagwu into :gwuRow
C/END-EXEC

 /FREE
    if sqlstt = '00000';

    // VSRCMB contains name of the source member. Override to this source
    // member with this name.
      if ovrdbfFlag = '0';
        qcmd =
            'OVRDBF FILE(QRPGLESRC) ' +
            'TOFILE(' + %trim(inSrcLibNam) +
            '/QRPGLESRC) '+
            'MBR(' + %trim(VSRCMB) +')';
        CallP(e) Qcmdexc(qcmd : %Len(%Trim(qcmd)));
        exsr crtNewMbr;
        ovrdbfFlag = '1';
      endif;

    // Find program parameters, update the source member
    procCall = %trim(vname) + '(';
    exsr findParms;
    exsr updSrcMbr;

    endif;
  enddo;
 /END-FREE

C/EXEC SQL
C+   close csr_xagwu
C/END-EXEC SQL
```

```
 /FREE
   // Insert the prototype copybook.
   // Last, delete override to src file members
   if ovrdbfFlag = '1';
     exsr insProCpyBk;
     qcmd = 'DLTOVR FILE(QRPGLESRC) ';
     CallP(e) Qcmdexc(qcmd : %Len(%Trim(qcmd)));
     qcmd = 'DLTOVR FILE(QRPGLENEW) ';
     CallP(e)  Qcmdexc(qcmd : %Len(%Trim(qcmd)));
   endif;
  endsr;

   // ----------------------------------------------------------------
  begsr findParms;
   // Find source statements that contains the parameters
   // that follow the program call
   // ----------------------------------------------------------------

   // VRECN contains relative record number of the source statement
   //   that contains the Call to the program. By selecting all
   //   records greater than this RRN, we can find all parms
   //   that follow the program call.
 /END-FREE
C/EXEC SQL
C+ declare csr_qrpglesrc CURSOR FOR
C+ select srcdta,  rrn(qrpglenew)
C+   from qrpglenew
C+   where rrn(qrpglenew) > :VRECN
c+   order by rrn(qrpglenew)
C/END-EXEC
C/EXEC SQL
C+   open csr_qrpglesrc
C/END-EXEC SQL
 /FREE
  parmCount = 0;
  dou sqlstt <> '00000';
 /END-FREE
C/EXEC SQL
C+   fetch csr_qrpglesrc into :srcMbrRow
C/END-EXEC

 /FREE
    // See if the rpg statement following the call contains a
    // parameter operation. This assumes that the PARM operations
    // immediately follow the CALL operation (not using the PLIST
    // operation)
    if sqlstt <> '00000';
      leave;
    endif;

  // Skip comment lines
    if %subst(srcstm:7:1) = '*';
      iter;
    endif;

    // Convert the source statment to upper case. Then compare
    // the contents of the source statement at positions 26-29 with 'PARM'
    // If no match, leave the loop, we are done.
    srcStmUC = %xlate(lower : upper : srcStm);
    if %subst(srcStmUC:26:4)<>'PARM';
```

```
      leave;
    endif;

    // If we are here, we have found a PARM statement. Extract parm and
    // construct parameter list in prototyped call format.
    parmCount = parmCount + 1;
    parmNam = %subst(srcStmUC:50:10);
    parmArray(parmCount) = parmNam;
    parmLenArr(parmCount) =
        %subst(srcStmUC:64:5);
    parmDecLenArr(parmCount) =
        %subst(srcStmUC:69:2);
    if parmCount = 1;
      procCall = %trim(procCall) + %trim(parmNam);
    else;
      procCall = %trim(procCall) + ' : ' + %trim(parmNam);
    endif;
  enddo;
  procCall = %trim(procCall) + ')';

 /END-FREE
C/EXEC SQL
C+   close csr_qrpglesrc
C/END-EXEC SQL
 /FREE
  endsr;

  //  ----------------------------------------------------------------
  begsr updSrcMbr;
  // Update the line that contains the program call. Replace program
  // call with prototyped call.
  //  ----------------------------------------------------------------
  newLine = *blanks;
  %subst(newline:6:1) = 'c';
  %subst(newline:26:5) = 'callp';
  %subst(newline:36:35)= procCall;
 /END-FREE

C/EXEC SQL
C+ update qrpglenew
C+ set srcdta = :newLine
C+ where rrn(qrpglenew) = :VRECN
C/END-EXEC

 /FREE
  // Delete the lines following the pgm call that contain the
  // PARM operation
  for pc = 1 to parmCount;
    %subst(newline:6:2) = ' *';
    nxtRRN = vrecn + pc;
 /END-FREE
C/EXEC SQL
C+ delete from qrpglenew
C+ where rrn(qrpglenew) = :nxtRRN
C/END-EXEC
 /FREE
  endfor;

  genProFlag = '1';
  endsr;
```

```
  //  ---------------------------------------------------------------
  begsr GenPrototype;
    // Creates new source file member 'prototypes' in the src fil lib &
    // generates new prototype for the prototyped call
    //  ---------------------------------------------------------------

    // Add new mbr to src file (assumes that it does not already exist)
    // and override to this new mbr
    qcmd =
        'ADDPFM FILE(' +
        %trim(inSrcLibNam) + '/QRPGLESRC) '+
        'MBR(PROTOTYPES) SRCTYPE(RPGLE)';
    CallP(e) Qcmdexc(qcmd : %Len(%Trim(qcmd)));
    qcmd =
        'OVRDBF FILE(QRPGLESRC) ' +
        'TOFILE(' + %trim(inSrcLibNam) +
        '/QRPGLESRC) '+
        'MBR(PROTOTYPES)';
    CallP(e) Qcmdexc(qcmd : %Len(%Trim(qcmd)));

    // Generate prototype by adding new lines to member
    pr_srcSeq = 1;
    pr_srcdta = *blanks;
    %subst(pr_srcdta:6:1) = 'd';
    %subst(pr_srcdta:8:10) = inPgmNam;
    %subst(pr_srcdta:24:2) = 'pr';
    %subst(pr_srcdta:44:20) =
        'extpgm(''' + %trim(inPgmNam) + ''')';
    pr_srcdat = srcdat;
 /END-FREE
C/EXEC SQL
c+   insert into qrpglesrc
c+   values (:protoRow)
C/END-EXEC
 /FREE
    for pc = 1 to parmCount;
      pr_srcSeq = pc + 1;
      pr_srcdta = *blanks;
      %subst(pr_srcdta:6:1) = 'd';
      %subst(pr_srcdta:10:10) = ParmArray(pc);
      %subst(pr_srcdta:35:5) = ParmLenArr(pc);
      %subst(pr_srcdta:41:2)=ParmDecLenArr(pc);
      if ParmDecLenArr(pc) = *blanks;
        %subst(pr_srcdta:40:1) = 'a';
      else;
        %subst(pr_srcdta:40:1) = 'p';
      endif;
 /END-FREE
C/EXEC SQL
c+   insert into qrpglesrc
c+   values (:protoRow)
C/END-EXEC
 /FREE
    endfor;

    qcmd =
        'DLTOVR FILE(QRPGLESRC) ';
    CallP(e) Qcmdexc(qcmd : %Len(%Trim(qcmd)));
  endsr;
```

```
  //  ---------------------------------------------------------------
  begsr InsProCpyBk;
    // Insert prototype copybook statement in D-specs
    // The lines of source file members appear in arrival sequence.
    // This means, unfortunately, that new lines cannot just be
    // inserted in source file members.
    // The records of the member must be read and written to a
    // temp space. When you arrive at the point in which you want to
    // insert the new line, write that new line to the temp space.
    // Once you've written the whole member to the temp space (including the
    // newly inserted lines), delete all records from the original mbr, and
    // copy all rows from the temp back back into original src mbr
    //  ---------------------------------------------------------------

    insCbkFlag = '0';

    // Create and clear a temp table to store temp results
 /END-FREE
C/EXEC SQL
c+   create table qtemp/qrpgletmp as
c+   (select * from qrpglesrc) with no data
C/END-EXEC
C/EXEC SQL
c+   delete from qtemp/qrpgletmp
C/END-EXEC

 // Open cursor for original source member (we still
 // have an override on it at this point)
C/EXEC SQL
C+ declare csr_qrpglesrc2 CURSOR FOR
C+ select *
C+ from qrpglenew
c+ order by rrn(qrpglenew)
C/END-EXEC
C/EXEC SQL
C+   open csr_qrpglesrc2
C/END-EXEC SQL

 /FREE
  // Fetch the rows from the orignal source member
  dou sqlstt <> '00000';
 /END-FREE

C/EXEC SQL
C+   fetch csr_qrpglesrc2 into :rpgleRow
C/END-EXEC

 /FREE
    if sqlstt <> '00000';
      leave;
    endif;

    // Find first D-spec and insert the prototype statement
    // immediately before that statement
    specCode = %subst(srcDta:6:1);
    if (specCode = 'd' or specCode = 'D')
          and insCbkFlag = '0';
      i_srcSeq = srcSeq - .01;
      i_srcdta = *blanks;
```

```
      %subst(i_srcdta:7:20) = '/copy prototypes';
      i_srcdat = srcdat;
      insCbkFlag = '1';
 /END-FREE
C/EXEC SQL
c+   insert into qrpgletmp
c+   values (:insertRow)
C/END-EXEC
 /FREE
    endif;

    // Write the original source member record to the temp table
 /END-FREE
C/EXEC SQL
c+   insert into qrpgletmp
c+   values (:rpgleRow)
C/END-EXEC

 /FREE
  enddo;

  // Now clear the records from the original source member
  // and copy all records from temp table into it
 /END-FREE
C/EXEC SQL
c+   delete from qrpglenew
C/END-EXEC
C/EXEC SQL
c+   insert into qrpglenew
c+    select * from qrpgletmp
c+    order by rrn(qrpgletmp)
C/END-EXEC
C/EXEC SQL
C+   close csr_qrpglesrc2
C/END-EXEC SQL

 /FREE
  endsr;

    //  ----------------------------------------------------------------
  begsr crtNewMbr;
    // Create new source member to store results of conversion
    //  ----------------------------------------------------------------

    // Create new member. Use old member name and change name to start with Z
    newMbrNam = vSrcMb;
    %subst(newMbrNam:1:1) = 'Z';
    qcmd =
        'ADDPFM FILE(' +
        %trim(inSrcLibNam) + '/QRPGLESRC) '+
        'MBR(' + %trim(newMbrNam) +') SRCTYPE(RPGLE)';
    CallP(e) Qcmdexc(qcmd : %Len(%Trim(qcmd)));
    qcmd =
        'OVRDBF FILE(QRPGLENEW) ' +
        'TOFILE(' + %trim(inSrcLibNam) +
        '/QRPGLESRC) '+
        'MBR(' + %trim(newMbrNam) +')';
    CallP(e) Qcmdexc(qcmd : %Len(%Trim(qcmd)));

    // Clear a temp table to store temp results
```

```
 /END-FREE
C/EXEC SQL
c+   delete from qrpglenew
C/END-EXEC
C/EXEC SQL
c+   insert into qrpglenew
c+    select * from qrpglesrc
c+    order by rrn(qrpglesrc)
C/END-EXEC
 /FREE
  endsr;
```

4.6 Performing field re-engineering

This section introduces you to the field re-engineering capabilities of X-Analysis. By definition, field re-engineering means changing the attributes of an existing database field. The primary example of field re-engineering is field expansion. The effects of a field re-engineering change may be far-reaching and have a profound impact on the application. The database file itself must be changed, as well as all of the dependent logical files, display files, programs, modules, and service programs that reference that field. In addition, renamed fields, program parameters, and work variables also must be considered; thus the importance of the tool to identify object dependencies, perform the necessary impact analysis, carry out the actual source member conversion (for all of the impacted files and programs), and execute all of the necessary recompiling.

The field re-engineering process is performed by X-Resize, an X-Analysis extension. X-Resize utilizes X-Analysis impact analysis capabilities to identify all objects that are affected by the field change. It performs the necessary conversions by updating the source file members (if deemed necessary) of all identified objects and recompiling those objects.

The underlying function of X-Analysis that performs the impact analysis is called Variable Where Used (VWU). VWU lists all of the source lines where the field or variable of a file or program has been used or referenced in the Member source and its associated device files and copybooks, throughout the application. For more information about VWU and the view levels, refer to 4.2.1, “Variable Where Used” on page 114.

Important: When the impact analysis is performed for field re-engineering, View Level 5 is used to determine field usage.

The example field re-engineering process scenario identifies a field expansion effort. This scenario requires expanding the Customer Number field throughout the Customer Management System application. This field expansion could take place if either the maximum customer number value is about to be exceeded or the length of the field must expand to make the application more compatible with an external system or interface. The current length of the CUSNO (Customer Number) field in all of the files is packed 5,0 and the field expansion requirement is to expand it to packed decimal 7,0.

To do this, the following activities are carried out:

- Create and initialize a new resize project.
- Set up searching and run field searches.
- Identify fields to be changed.
- Build a list of objects to be converted.
- Run the conversion.
- Identify potential problems.

4.6.1 Creating a new resizing project

To create a new resize project, perform the following steps:

1. From a 5250 session, sign on with your user profile.
2. On an OS/400 command line, type the `EDTLIBL` command and press Enter.
3. At the Edit Library List screen, enter the libraries `XAN4` and `XRESIZE`. You may have other libraries in your library list, but make sure that you have the four libraries in the sequence shown in Figure 4-53. Press Enter.

```
Edit Library List
                                                          System:   RCHAS12
Type new/changed information, press Enter.

Sequence                  Sequence                  Sequence
 Number   Library          Number   Library          Number   Library
     0                      150                       300
    10    XRESIZE           160                       310
    20    XAN4              170                       320
    30    QGPL              180                       330
    40    QTEMP             190                       340
    50                      200                       350
    60                      210                       360
    70                      220                       370
    80                      230                       380
    90                      240                       390
   100                      250                       400
   110                      260                       410
   120                      270                       420
   130                      280                       430
   140                      290                       440
                                                                    More..
F3=Exit   F5=Refresh   F12=Cancel
Library list changed.
```

Figure 4-53 EDTLIBL command screen

4. On the OS/400 command line, type the command `XWRKPRJ` and press Enter. The Work with X-Resize Projects screen (Figure 4-54) appears.

```
X-Resize           Work with X-Resize Projects              Databorough Ltd.
XRRWKPRJ                                                           09:55:53
                                                                16 Sep 2005
Enter options, press Enter.
1=Initialise 2=Change 4=Delete 5=Display 6=Work with searches
7=Work with fields 8=Build lists 9=Work with lists 10=Work with conversions...

   Project    Status       X-A Lib    Project Description



F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
```

Figure 4-54 Work with X-Resize Projects

5. At the Work with X-Resize Projects screen, press F6 (Add) to add a new X-Resize project.

6. A detail screen appears (Figure 4-55), which is used to add a new resize project. To create the X-Resize project, enter the following information:

   Project Name XRAPPCUSNO (the name of our project). This project name follows the naming convention of the original cross-reference repository XRAPPSGCX.

   X-Analysis Library XRAPPSGCX (the name of the existing cross-reference repository).

   Project Description Field expansion project for CUSNO file.

   Press Enter.

```
X-Resize           Work with X-Resize Projects               Databorough Ltd.
XRRWKPRJ                                                             10:59:28
                                                                  09 Sep 2005
 Project Name . . . . . . . . .    XRAPPCUSNO
 Project Status . . . . . . . .
 X-Analysis Library . . . . . .    XRAPPSGCX
 Project Description  . . . . .    Field expansion project for CUSNO file


F1=Help  F3=Exit  F12=Cancal
```

Figure 4-55 Add new X-Resize Project screen

The new project XRAPPCUSNO is created (Figure 4-56). In addition, a new library XRAPPCUSNO is created and is associated with the cross-reference library XRAPPSGCX.

```
X-Resize           Work with X-Resize Projects               Databorough Ltd.
XRRWKPRJ                                                             10:59:28
                                                                  09 Sep 2005
Enter options, press Enter.
1=Initialise 2=Change 4=Delete 5=Display 6=Work with searches
7=Work with fields 8=Build lists 9=Work with lists 10=Work with conversions...

   Project    Status       X-A Lib    Project Description

   XRAPPCUSNO Created      XRAPPSGCX  Field expansion project for CUSNO file


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
Project added.
```

Figure 4-56 Work with X-Resize Projects screen

4.6.2 Initializing the resize project

The new project must be initialized. The initialization process creates a data dictionary for all fields and all objects used in the application. To initialize the resize project, perform the following steps.

At the Work with X-Resize Projects screen, select option **1** (Initialise) next to the XRAPPCUSNO project and press Enter. A batch job (XRESIZEJOB) is submitted to create the project database and complete the initialization.

Tip: To determine whether the batch job has completed, press F15 (DSPMSG) from the Work with X-Resize Projects screen. You can work with the submitted job by pressing F14 (WRKSBMJOB) at this screen. These function keys are provided from this screen so that you do not have to exit the tool and return to the OS/400 command line to check on the job.

When initialization has completed, the project status changes to `Intialised` (Figure 4-57).

```
X-Resize           Work with X-Resize Projects               Databorough Ltd.
XRRWKPRJ                                                             11:43:53
                                                                  09 Sep 2005
Enter options, press Enter.
1=Initialise 2=Change 4=Delete 5=Display 6=Work with searches
7=Work with fields 8=Build lists 9=Work with lists 10=Work with conversions...

   Project    Status       X-A Lib    Project Description

   XRAPPCUSNO Initialised  XRAPPSGCX  Field expansion project for CUSNO file


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
(C) Copyright Databorough Ltd. England 2002.
```

Figure 4-57 Work with X-Resize Projects

4.6.3 Identifying fields to change

With the project initialized, the next step is identify the fields to expand. This may be done with either of two methods:

- Set up and run searches.
- Change fields on the Work with Projects Fields screen.

Setting up searches

Manually locating and identifying all the fields to expand can potentially be a daunting task, especially if a data dictionary is not available in your environment. The fields may be dispersed throughout the application database files and may not follow consistent naming conventions. To aid in this effort, X-Analysis provides a global search capability. X-Analysis uses the search word to scan all relevant data against each field in each database file in the project.

The search is not case sensitive. It scans for keyword matches in the following places in the database file field descriptions:

- Field names
- Field text
- Column headings
- Aliases

To set up a new search:

1. At the Work with X-Resize Projects screen (Figure 4-58), select option 6 (Work with searches) next to the XRAPPCUSNO project and press Enter.

```
X-Resize           Work with X-Resize Projects               Databorough Ltd.
XRRWKPRJ                                                             14:06:25
                                                                  09 Sep 2005
Enter options, press Enter.
1=Initialise 2=Change 4=Delete 5=Display 6=Work with searches
7=Work with fields 8=Build lists 9=Work with lists 10=Work with conversions...

   Project    Status       X-A Lib    Project Description

6  XRAPPCUSNO Initialised XRAPPSGCX  Field expansion project for CUSNO file


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
```

Figure 4-58 Work with X-Resize Projects screen

2. The Work with X-Resize Searches screen (Figure 4-59) appears. Press F6 (Add) to add a new X-Resize search.

```
X-Resize           Work with X-Resize Searches               Databorough Ltd.
 XRRWKSCH                                                            14:06:25
                                                                  09 Sep 2005
 Enter options, press Enter.
 1=Run search 2=Change 4=Delete 5=Display 6=Run search incl. aliases
 7=Work with exclusions

    Search Word           + Option   Field Type, Length, Decs.


 F1=Help  F3=Exit  F4=Run all  F5=Run all/aliases  F6=Add  F24=More keys
```

Figure 4-59 Work with X-Resize Searches

This opens the screen to add a new search word. This screen is used to specify the search criteria of the fields you are looking for. Here is a description of the information that can be specified from this screen:

Search Word Specifies the search word; the search is not case sensitive.

Increment When a match is found, it specifies the increment length to apply to the field length automatically.

Note: If a field had a new length assigned, then it appears on the Work with Fields screen when F8 is pressed to display only selected fields.

Option Specifies whether to Add or Replace results. Valid values are:

A Add the results of the search to any existing selected fields.

R Replace all current selected fields with the results of this search.

Note: If you submit a request to run all specified searches, then the first search will automatically be run in Replace mode.

Field Type Specifies that only certain types of fields are included in the search. Valid values are:

C - only character fields are included.

N - only numeric fields are included.

Note: If you do not enter a value in the field type, all field types are included in the search.

Field Length Specifies that only fields of a certain length are included in the search.

Note: If no search word is specified but the field length (and optionally, decimal places) is specified, then any fields meeting the length criterion will be selected.

Field Decimal Places Specifies that only fields with a certain number of decimal places are included in the search. It is, of course, only valid to specify the number of decimal places for numeric fields.

Note: If you do not enter a field length or the number of decimal places (where appropriate), then fields of all lengths (and with any number of decimal places) will be considered.

Tips:

- You can make the search more specific by specifying the field type, the field length, and the number of decimal places for candidate fields.
- If you use exclusion words with search criteria where only the length has been specified, then they will apply to each criterion where only the length has been specified.

3. For this example, enter a search for `CUSNO` as shown in Figure 4-60 and press Enter.

```
X-Resize          Work with X-Resize Searches              Databorough Ltd.
XRRWKSCH                                                          14:09:19
                                                               09 Sep 2005

 Search Word  . . . . . .    CUSNO
 Increment  . . . . . .       2
 Option . . . . . . . . .    A
 Field Type . . . . . .      N
 Field Length . . . . . .        5
 Field Decimal Places . . . . .   0



F1=Help  F3=Exit  F12=Cancel
```

Figure 4-60 Add X-Resize Search Word screen

The search criteria is added and you return to the Work with X-Resize Searches screen (Figure 4-61).

```
X-Resize           Work with X-Resize Searches               Databorough Ltd.
XRRWKSCH                                                             15:36:12
                                                                  09 Sep 2005
Enter options, press Enter.
1=Run search 2=Change 4=Delete 5=Display 6=Run search incl. aliases
7=Work with exclusions

   Search Word           + Option   Field Type, Length, Decs.

   CUSNO                 2 *ADD     Numeric          5     0



F1=Help  F3=Exit  F4=Run all  F5=Run all/aliases  F6=Add  F24=More keys
```

Figure 4-61 Work with X-Resize Searches screen

More search words can be added by iteratively following the process we just described. The screen shown in Figure 4-62 is a result of adding multiple search words. This is done to demonstrate how to handle variations in field naming conventions. Notice that searches for prospect number have also been defined. For this application, we have identified that both customer number and prospect number have to be expanded, so both variations are included in the search. It is important to be thorough and give the tool enough information to find all possible instances of the fields that you want to expand.

```
X-Resize           Work with X-Resize Searches               Databorough Ltd.
XRRWKSCH                                                             15:36:12
                                                                  09 Sep 2005
Enter options, press Enter.
1=Run search 2=Change 4=Delete 5=Display 6=Run search incl. aliases
7=Work with exclusions

   Search Word           + Option   Field Type, Length, Decs.

   CUS. NO.              2 *ADD     Numeric          5     0
   CUSNO                 2 *ADD     Numeric          5     0
   CUSNUM                2 *ADD     Numeric          5     0
   CUST NO               2 *ADD     Numeric          5     0
   CUST NUM              2 *ADD     Numeric          5     0
   CUST NUMBER           2 *ADD     Numeric          5     0
   CUSTOMER NUMBER       2 *ADD     Numeric          5     0
   PROSPECT NO           2 *ADD     Numeric          5     0
   PROSPECT NUM          2 *ADD     Numeric          5     0
   PROSPECT NUMBER       2 *ADD     Numeric          5     0


F1=Help  F3=Exit  F4=Run all  F5=Run all/aliases  F6=Add  F24=More keys
```

Figure 4-62 Work with X-Resize Searches screen

Setting up search exclusions

You can also enter exclusion words against a specific search word to indicate that the search is invalid if the exclusion word is also present. Although you do not specify any search exclusions in this example, we now look at the Work with Search Exclusion screens:

1. At the Work with X-Resize Searches screen, select option 7 (Work with exclusions) next to the search word (CUSNO) and press Enter.
2. The Work with X-Resize Search Exclusions screen appears. Press F6 (Add) at this screen to display the screen from which to add a new search exclusion.
3. The screen used to add search exclusions appears (Figure 4-63). From here you would specify exclusion words to indicate that although the search has found a match, the search should be discounted if the exclusion word is also present. You are not adding a search exclusion in this example, so press F12 (Cancel) twice to return to the Work with X-Resize Search Screen.

```
X-Resize           Work with X-Resize Search Exclusions       Databorough Ltd.
XRRWKSHX                                                             14:33:30
                                                                  09 Sep 2005
 Search Word  . . . . . .    CUSNO
 Exclusion Word . . . . . .  TEST

F1=Help  F3=Exit  F12=Cancel
```

Figure 4-63 Add X-Resize Search Exclusion screen

Running the search

After entering the words to search, you can run the search.

1. At the Work with X-Resize Searches screen, press F5 to run the search of all specified search words. As an alternative method, you can select option 6 next to each search word and press Enter. A batch job to perform the word search is submitted.

   Tip: To determine whether the batch job has completed, press F15 (DSPMSG) at the Work with X-Resize Searches screen. You can also work with the submitted job by pressing F14 (WRKSBMJOB) at this screen. These function keys are provided at this screen so that you do not have to exit the tool and return to the OS/400 command line.

2. Press F12 to return to the Work with X-Resize Projects screen.

3. When the batch job has completed, you see the results of the search. At the Work with X-Resize Projects screen, press F8 (All/selected) to toggle the view from all files to fields selected by the search. All fields matching the search are presented. Notice in Figure 4-64 that the field length has automatically been incremented (from 5 to 7) under the New Vals column.

```
X-Resize           Work with X-Resize Project Fields          Databorough Ltd.
XRRWKFLD                                                             15:33:50
                                                                  09 Sep 2005
Position on:
Enter options, press Enter.
2=Change 4=Delete 5=Display 6=Field usage 7=File usage


   Field      File        Curr. Vals    New Vals Field text...

   CNACUST    CNPHSD         3  5  0     4  7  0 CUSTOMER NUMBER
   CNACUST    CNPHST         3  5  0     4  7  0 CUSTOMER NUMBER
   CNVCUST    CNPCNS         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCCCUST   CUTCON         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCCUST    CUTMST         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCLCUST   CUTCLC         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCSCUST   CUTSLM         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCSCUST   CUTSRI         3  5  0     4  7  0 CUSTOMER NUMBER
   CUSNO      CNTACS         3  5  0     4  7  0 Cus. No.
   CUSNO      CUSF           3  5  0     4  7  0 Cus. No.
   CUSNO      CUSTS          3  5  0     4  7  0 Prospect No                +

F1=Help  F3=Exit  F6=Add  F7=File/field sequence F24=More keys
```

Figure 4-64 Work with X-Resize Project Fields screen

4.6.4 Explicitly identifying fields to change

Another method for identifying fields to change is to explicitly change the field lengths at the Work with Project Fields screen. This is a more manual process as it requires you to scroll through the list of fields in the cross-reference database, locate each of the fields to change, and change them. To be thorough, you could use both methods (field searching and changing fields) but in general, searches should be used to avoid having to identify each individual field manually.

Displaying global usage of a selected field

Prior to identifying the fields to resize, you may need to gather more information about the fields and files being used. To display field usage information:

1. At the Work with X-Resize Project Fields screen, select option 6 (Field usage) next to the CUSNO field and press Enter.

2. A window displaying field usage information for the specified field appears (Figure 4-65). The three columns in this window show:
   - The sequence number of the source file member containing the field reference.
   - The name of the source file member containing the field reference.
   - The first 40 characters of the actual source file member statement that contains the field reference.

   From this window, you can jump to a summary view of the field usage information. To do this, type *SUMMARY in the input field following Level: (right upper corner of screen) and press Enter.

```
Variable Where Used: CUSNO                              Level: *DETAIL
       4.00 CLET                    DCL        VAR(&CUSNO) TYPE(*DEC
       9.00 CLET                    CHGVAR  &CUSNO &CUSNC
      10.00 CLET                    CALL LETN1 (&CUSNO &PREFIX &LETS
       1.00 CLETN                   PGM        PARM(&CUSNO &PREFIX &
       3.00 CLETN                   DCL        VAR(&CUSNO) TYPE(*DEC
      10.00 CLETN                   CALL LETN1 (&CUSNO &PREFIX &LLET
       3.00 CNTACS          A            CUSNO          5P 0       T
      21.00 CNTACS          A          K CUSNO
      97.00 CNTCMAINT       C                  eval      zcusno = c
     116.00 CNTCMAINT       C                  eval      cusno = zc  +
```

Figure 4-65 X-Resize Project Field usage detail screen

3. A window displaying field usage information for the specified field appears (Figure 4-66). The four columns in this window show:
   - The sequence number of .00 (because this is a summary level view).
   - The name of the source file member containing the field reference.
   - The name of the source file containing the member.
   - The name of the library that contains the source file.

   Press F12 to return to the Work with X-Resize Project Fields screen.

```
Variable Where Used: CUSNO                              Level: *SUMMARY
        .00 CLET       QCLSRC     XRAPPSGC
        .00 CLETN      QCLSRC     XRAPPSGC
        .00 CNTACS     QDDSSRC    XRAPPSGC
        .00 CNTCMAINT  QRPGLESRC  XRAPPSGC
        .00 CNTLF3     QDDSSRC    XRAPPSGC
        .00 CNTLF4     QDDSSRC    XRAPPSGC
        .00 CPDM       QCLSRC     XRAPPSGC
        .00 CSEC       QCLSRC     XRAPPSGC
        .00 CSEC2      QCLSRC     XRAPPSGC
        .00 CUSCPY     QRPGSRC    XRAPPSGC                          +
```

Figure 4-66 X-Resize Project Field usage summary screen

Displaying Global Usage of a selected file

To further aid you in identifying fields to resize, you may need more information about the file usage. To display file usage information, perform the following steps:

1. At the Work with X-Resize Project Fields screen, select option 7 (File usage) next to the CUSNO field for the CNTACS file and press Enter.

```
X-Resize           Work with X-Resize Project Fields          Databorough Ltd.
XRRWKFLD                                                              10:55:26
                                                                   12 Sep 2005
Position on:
Enter options, press Enter.
2=Change 4=Delete 5=Display 6=Field usage 7=File usage

   Field      File        Curr. Vals    New Vals Field text...

7  CUSNO      CNTACS         3  5  0     4  7  0 Cus. No.
   CUSNO      CUSF           3  5  0     4  7  0 Cus. No.
   CUSNO      CUSTS          3  5  0     4  7  0 Prospect No
   CUSNO      CUTMST         3  5  0     4  7  0 Cus. No.
   CUSNO      SECF           3  5  0     4  7  0 Cmp.No.
   CUST       XFRF           3  5  0     4  7  0 CUSTOMER NUMBER
   CUSV       XFRF          15  0  0     0  0  0 CURRENT SUPERVISOR
   CUSY       XFRF           1  0  0     0  0  0 CURRENCY SYMBOL
   CUT        XFRF           1  0  0     0  0  0 CREATE CUT HISTORY   -Y/N
   CUTIMESTMP CUTCLC        26  0  0     0  0  0 TIMESTAMP
   CUTIMESTMP CUTCON        26  0  0     0  0  0 TIMESTAMP                  +

F1=Help  F3=Exit  F6=Add  F7=File/field sequence F24=More keys
```

Figure 4-67 Work with X-Resize Project Fields screen

A window (Figure 4-68) displaying field usage information for the specified field appears. Four columns are displayed in this window:

- The name of the object that contains the file reference
- The text description of the object that contains the file reference
- The object type of the referencing object. Valid values are:

  P Program

  F File

  D Data Area
- The way the specified object is used within the referring object. Valid values are:

  I Input file

  U Update file

  O Output file

  A Input and output file

  B Update & output or input/update/output file

```
Object: CNTACS     *FILE      Contacts
     CNTCMAINT  Contacts Maintenance                          P U
     GCNTAC1    Generate Prospect Record                      P O
     WWCCONS    Work with Customer Contacts                   P I
     CNTLF1     Global Contacts by Salesman
     CNTLF2     Global Contacts by Name
     CNTLF3     Global Contacts by Status
     CNTLF4     Global Contacts by Prod & Status

  (C) Copyright Databorough Ltd. 2001
```

Figure 4-68 X-Resize Project File usage screen

Changing the selected field

After you have collected enough information about field and file usage and are ready to proceed, you can explicitly identify the fields to expand by changing their field lengths.

In our example we have found a field that requires expansion and was not located by the search function. The field name is CNACUST in file CNPOPC and its text is CUSTOMER/TENANT NUMBER. You did not define a search word with this pattern, so it was not included in the search results. This field must be explicitly identified for field expansion.

1. At the Work with X-Resize Project Fields screen (Figure 4-69), select option 2 (Change) next to the field name (CNACUST) for file CNPOPC and press Enter.

> **Tip:** Use the Position On field in the Work with X-Resize Project Fields screen to specify a field to position to in the list. The field appears on the first line of the displayed part of the list. This eliminates the need to page up and page down to find the desired field.

```
X-Resize           Work with X-Resize Project Fields          Databorough Ltd.
XRRWKFLD                                                             11:58:51
                                                                  12 Sep 2005
Position on:
Enter options, press Enter.
2=Change 4=Delete 5=Display 6=Field usage 7=File usage


   Field      File        Curr. Vals    New Vals Field text...

   CNACSDV    CNPOPC        2  3  0     0  0  0 CASH DIVISION NUMBER
   CNACSPO    CNPHST       15  0  0     0  0  0 CUSTOMER P/O NUMBER
   CNACSPO    CNPOPC       15  0  0     0  0  0 CUSTOMER P/O NUMBER
   CNACUCD    CNPOPC        1  0  0     0  0  0 CURRENT PAYMENT CODE
   CNACUST    CNPHSD        3  5  0     4  7  0 CUSTOMER NUMBER
   CNACUST    CNPHST        3  5  0     4  7  0 CUSTOMER NUMBER
2  CNACUST    CNPOPC        3  5  0     0  0  0 CUSTOMER/TENANT NUMBER
   CNAD       XFRF         25  0  0     0  0  0 CONTACT ADDRESS
   CNADENO    CNPHSD        2  3  0     0  0  0 DEDUCTION NUMBER
   CNADICO    CNPHSD        2  2  0     0  0  0 DISTRIBUTION COMPANY
   CNADIDV    CNPHSD        2  3  0     0  0  0 DISTRIBUTION DIVISION       +

F1=Help  F3=Exit  F6=Add  F7=File/field sequence F24=More keys
```

Figure 4-69 Work with X-Resize Project Fields

2. The screen to change the project field appears. Type 7 for the New Length value (Figure 4-70) and press Enter.

```
X-Resize          Work with X-Resize Project Fields          Databorough Ltd.
XRRWKFLD                                                             11:58:51
                                                                  12 Sep 2005
 File . . . . . .    CNPOPC
 Field  . . . . . .  CNACUST
 Current Length . . . . . .      5
 Current Decimal Positions  . .  0
 New Length . . . . . .          7
 New Decimal Positions  . . . .  0
 Field Type . . . . . .          P
 Field Text . . . . . .          CUSTOMER/TENANT NUMBER

 Column Heading 1 . . . . . .    CUST#
 Column Heading 2 . . . . . .
 Column Heading 3 . . . . . .
 Internal Field Name  . . . . .  CNACUST
 Field Alias  . . . . . .


F1=Help  F3=Exit  F12=Cancel
```

Figure 4-70 Change X-Resize Project Field

The record is changed and you are returned to the Work with X-Resize Project Fields screen (Figure 4-71).

```
X-Resize          Work with X-Resize Project Fields          Databorough Ltd.
XRRWKFLD                                                             11:58:51
                                                                  12 Sep 2005
Position on:
Enter options, press Enter.
2=Change 4=Delete 5=Display 6=Field usage 7=File usage


   Field      File        Curr. Vals    New Vals Field text...

   CNACSDV    CNPOPC        2  3  0     0  0  0 CASH DIVISION NUMBER
   CNACSPO    CNPHST       15  0  0     0  0  0 CUSTOMER P/O NUMBER
   CNACSPO    CNPOPC       15  0  0     0  0  0 CUSTOMER P/O NUMBER
   CNACUCD    CNPOPC        1  0  0     0  0  0 CURRENT PAYMENT CODE
   CNACUST    CNPHSD        3  5  0     4  7  0 CUSTOMER NUMBER
   CNACUST    CNPHST        3  5  0     4  7  0 CUSTOMER NUMBER
   CNACUST    CNPOPC        3  5  0     4  7  0 CUSTOMER/TENANT NUMBER
   CNAD       XFRF         25  0  0     0  0  0 CONTACT ADDRESS
   CNADENO    CNPHSD        2  3  0     0  0  0 DEDUCTION NUMBER
   CNADICO    CNPHSD        2  2  0     0  0  0 DISTRIBUTION COMPANY
   CNADIDV    CNPHSD        2  3  0     0  0  0 DISTRIBUTION DIVISION       +

F1=Help  F3=Exit  F6=Add  F7=File/field sequence F24=More keys
Record changed.
```

Figure 4-71 Work with X-Resize Project Fields

Displaying all fields identified for field expansion

At this point you have (via the two methods) identified all fields to be expanded. You can view a list of the fields from the Work with X-Resize Project Fields by using the F8 Toggle function:

1. At the Work with X-Resize Project Fields screen, press F8 (All/selected).

   Notice that the contents of the list (Figure 4-72) have changed. Prior to pressing F8, all fields in the cross-reference library were displayed. Now only those found by the search or that have explicitly changed appear on the screen.

   Also notice that each value in the Curr. Vals columns is 3,5,0 (3 for the buffer length, 5 for field length, 0 for decimal positions) and in New Vals it is 4,7,0. This change in the field length determines what is shown in the list. All fields that have new values that differ from their current values are displayed. In the case of those identified by the search, their new value was incremented from 5 to 7 automatically. You explicitly changed the length of the CNACUST field in the CNPOPC file.

```
X-Resize           Work with X-Resize Project Fields          Databorough Ltd.
XRRWKFLD                                                              11:58:51
                                                                   12 Sep 2005
Position on:
Enter options, press Enter.
2=Change 4=Delete 5=Display 6=Field usage 7=File usage


   Field      File        Curr. Vals    New Vals Field text...

   CNACUST    CNPHSD         3  5  0     4  7  0 CUSTOMER NUMBER
   CNACUST    CNPHST         3  5  0     4  7  0 CUSTOMER NUMBER
   CNACUST    CNPOPC         3  5  0     4  7  0 CUSTOMER/TENANT NUMBER
   CNVCUST    CNPCNS         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCCCUST   CUTCON         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCCUST    CUTMST         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCLCUST   CUTCLC         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCSCUST   CUTSLM         3  5  0     4  7  0 CUSTOMER NUMBER
   CUCSCUST   CUTSRI         3  5  0     4  7  0 CUSTOMER NUMBER
   CUSNO      CNTACS         3  5  0     4  7  0 Cus. No.
   CUSNO      CUSF           3  5  0     4  7  0 Cus. No.                    +

F8=All/selected  F10=Cmd line  F12=Cancel  F14=WRKSBMJOB  F24=More keys
```

Figure 4-72 Work with X-Resize Project Fields

2. Press F8 again to toggle back to displaying all fields in the cross-reference repository.
3. Press F12 to return to the Work with X-Resize Projects screen.

4.6.5 Building list of objects to be converted

You are can now build the list based on the identified fields:

1. At the Work with X-Resize Projects screen (Figure 4-73), select option 8 next to XRAPPCUSNO and press Enter.

```
X-Resize           Work with X-Resize Projects               Databorough Ltd.
XRRWKPRJ                                                             11:43:53
                                                                  09 Sep 2005
Enter options, press Enter.
1=Initialise 2=Change 4=Delete 5=Display 6=Work with searches
7=Work with fields 8=Build lists 9=Work with lists 10=Work with conversions...

   Project    Status       X-A Lib    Project Description

8  XRAPPCUSNO Initialised  XRAPPSGCX  Field expansion project for CUSNO file

F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
```

Figure 4-73 Work with X-Resize Projects

2. The SBMJOB command prompt screen appears (Figure 4-74). Press Enter to submit the batch job.

```
 Submit Job (SBMJOB)

 Type choices, press Enter.

 Command to run . . . . . > XBLDLISTS XRLIB(XRAPPCUSNO) XA4LIB(XRAPPSGCX)



                                                                      ...
 Job name . . . . . > XBLDLISTS     Name, *JOBD
 Job description  . . . . . .   *USRPRF       Name, *USRPRF
   Library  . . . . . .                       Name, *LIBL, *CURLIB
 Job queue  . . . . . .   *JOBD         Name, *JOBD
   Library  . . . . . .                       Name, *LIBL, *CURLIB
 Job priority (on JOBQ) . . . . .   *JOBD         1-9, *JOBD
 Output priority (on OUTQ)  . . .   *JOBD         1-9, *JOBD
 Print device . . . . . .   *CURRENT      Name, *CURRENT, *USRPRF...

                                                                     More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 4-74 SBMJOB XBLDLISTS command prompt screen

The command XBLDLISTS is submitted to batch. When the job completes, the status for the project changes to `Lists built` (Figure 4-75).

Tip: To determine whether the batch job has completed, press F15 (DSPMSG) at the Work with X-Resize Searches screen. To work with the submitted job, press F14 (WRKSBMJOB) from this screen. These function keys are provided for this screen so that you do not have to exit the tool and return to the OS/400 command line.

```
X-Resize           Work with X-Resize Projects               Databorough Ltd.
XRRWKPRJ                                                             10:43:40
                                                                  12 Sep 2005
Enter options, press Enter.
1=Initialise 2=Change 4=Delete 5=Display 6=Work with searches
7=Work with fields 8=Build lists 9=Work with lists 10=Work with conversions...

   Project    Status       X-A Lib    Project Description

   XRAPPCUSNO Lists built  XRAPPSGCX  Field expansion project for CUSNO file


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
```

Figure 4-75 Work with X-Resize Projects

Working with the conversion list

Now that the conversion list has been built, you can view and edit the contents. The conversion list contains the list of objects (files, programs, modules, and service programs) that are affected by the field expansion, and thus must be converted, compiled, or both. This list is built using the changed field data from the Work with X-Resize Project Fields screen.

To work with the conversion list:

1. At the Work with X-Resize Projects screen, select option 9 (Work with lists) next to the XRAPPCUSNO project and press Enter.
2. The Work with X-Resize Conversion Lists screen (Figure 4-76) appears, showing the list of objects to be converted. Also displayed are the object type, the conversion type, and the source member, file, and library.

   Conversion types:

   CONVERT The source member is updated to reflect the specified new length and the objects are recompiled.

   RECOMPILE The object is recompiled

   UPDPGM The program is updated using the UPDPGM command.

   To change the entry, select option **2** (Change) next to CNTACS and press Enter.

```
X-Resize           Work with X-Resize Conversion Lists        Databorough Ltd.
XRRWKLST                                                              15:38:02
                                                                   12 Sep 2005
Position on:
Enter options, press Enter.
2=Change 5=Display

   Obj. Type  Conv.Type  Object     Source Member, File, Library...  X F

2  *FILE      CONVERT    CNTACS     CNTACS     QDDSSRC    XRAPPSGC
   *FILE      CONVERT    CUSF       CUSF       QDDSSRC    XRAPPSGC
   *FILE      CONVERT    CUSTS      CUSTS      QDDSSRC    XRAPPSGC
   *FILE      CONVERT    CUTMST     CUTMST     QDDSSRC    XRAPPSGC
   *FILE      CONVERT    SECF       SECF       QDDSSRC    XRAPPSGC
   *FILE      RECOMPILE  CNTLF1     CNTLF1     QDDSSRC    XRAPPSGC
   *FILE      RECOMPILE  CNTLF2     CNTLF2     QDDSSRC    XRAPPSGC
   *FILE      RECOMPILE  CNTLF3     CNTLF3     QDDSSRC    XRAPPSGC
   *FILE      RECOMPILE  CNTLF4     CNTLF4     QDDSSRC    XRAPPSGC
   *FILE      RECOMPILE  CULMST06   CULMST06   QDDSSRC    XRAPPSGC
   *FILE      RECOMPILE  CUSFLA     CUSFLA     QDDSSRC    XRAPPSGC          +

F1=Help  F3=Exit  F10=Cmd line  F12=Cancel  F14=WRKSBMJOB  F24=More keys
```

Figure 4-76 Work with X-Resize Conversion Lists

3. The screen to change the conversion list object appears (Figure 4-77). From this screen, you can change two fields: Excluded and Reference Type.

   Excluded Specify “Y” to exclude the object from the conversion.

   Reference Type Specify:

   - F indicates that the object is a field reference file. These files are compiled first.
   - R indicates that the file is some other reference file. These files are compiled next followed by all other files.

   For this example, there are no changes to those fields. Press Enter.

```
X-Resize           Work with X-Resize Conversion Lists        Databorough Ltd.
XRRWKLST                                                             13:33:51
                                                                  12 Sep 2005

 Object Type  . . . . . .    *FILE
 Conversion Type  . . . . .  CONVERT
 Object . . . . . .          CNTACS
 Source Member  . . . . . .  CNTACS
 Source File  . . . . . .    QDDSSRC
 Source Library . . . . . .  XRAPPSGC
 Source Type  . . . . . .    PF
 Excluded . . . . . .
 Reference Type . . . . . .

F1=Help  F3=Exit  F12=Cancel
```

Figure 4-77 Change conversion list entry screen

4.6.6 Running a conversion

When all of the problems highlighted by the diagnostic reports have been addressed, you are ready to proceed with the conversion stage of the project. The complete conversion process contains the following stages:

1. Convert fields: The field definitions in the source members for the database files are converted.
2. Recompile files: The database files are recompiled.
3. Update files: The data is copied and mapped from the original database files to the converted database files.
4. Convert programs: Programs, service programs, and modules and any device files used by them are converted.
5. Recompile programs: Programs, service programs, and modules and any device files used by them are recompiled. (For ILE RPG programs and service programs, the modules are recompiled and the programs are updated.)
6. Reattach triggers: Any trigger programs attached to the original database files are attached to the converted database files.

The conversion can be run to completion in one step (using option 1 from the Work with X-Resize Conversion screen) or it can be broken down into incremental steps. In most environments, it is neither advisable or practical to run the conversion in one step. This is because most production environments are complex and require multiple levels of change management control. Successfully implementing a field re-engineering project in one step is not feasible due to the complex nature of most production environments.

A more practical approach is to conduct the conversion process in individual steps.

1. Set up conversion.
2. Conduct recompile of files and programs only.
3. Run field conversions and recompile objects.
   a. Convert fields and recompile files.
   b. Convert programs and recompile programs.
4. Perform analysis.
5. Import converted library into change management system.

Setting up a conversion

To set up a conversion, perform the following steps:

1. At the Work with X-Resize Projects screen, select option 10 (Work with conversions) next to the XRAPPCUSNO project and press Enter.
2. The Work with X-Resize Conversions screen appears (Figure 4-78). Press F6 (Add) to create a new conversion.

```
X-Resize           Work with X-Resize Conversions            Databorough Ltd.
XRRWKCNV                                                             16:03:00
                                                                  12 Sep 2005
Enter options, press Enter.
1=Run complete conversion 2=Change 4=Delete 5=Display 6=Convert fields
7=Recompile files 8=Update files 9=Convert programs 10=Recompile programs...

   Conversion Description                                    Type    Progress


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
```

Figure 4-78 Work with X-Resize Conversions screen

3. The screen to add a new conversion record is displayed. The following information can be entered at this screen:

Conversion Library The conversion library name should be the name of a new library, X-Resize creates specifically for this purpose.

Conversion Description Any descriptive text required.

Conversion Type The conversion type can be either:

- ***REPLACE** Replace the current source line with an amended one.
- ***ADD** Comment out the current source line and add a new amended) one immediately after it.

Notation type The notation type can be one of the following

- **MARGIN** Flag a changed source line in positions 1 to 5. The default value is XRSZE, however, you can specify any value using the data area XRMARGIN in the project library.
- **COMMENT** Flag a changed source line with a comment immediately preceding it.

BOTH Flag a changed source line by both of the above methods.

NEITHER Do not flag a changed source line (by either of the above methods).

Type the information as shown in Figure 4-79 and press Enter.

```
X-Resize           Work with X-Resize Conversions            Databorough Ltd.
XRRWKCNV                                                             16:22:22
                                                                  12 Sep 2005
 Conversion Library . . . . . .    XRAPPSCVCN
 Conversion Description . . . .    Conversion for CUSNO field expansion

 Conversion Type  . . . . . .      *ADD
 Notation Type  . . . . . .        BOTH
 Fields Converted . . . . . .
 Files Recompiled . . . . . .
 Files Updated  . . . . . .
 Programs Recompiled  . . . . .

F1=Help  F3=Exit  F12=Cancel
```

Figure 4-79 Add X-Resize Conversion screen

The conversion is added and you are returned to the Work with X-Resize Conversions screen (Figure 4-80).

```
X-Resize           Work with X-Resize Conversions            Databorough Ltd.
XRRWKCNV                                                             16:22:22
                                                                  12 Sep 2005
Enter options, press Enter.
1=Run complete conversion 2=Change 4=Delete 5=Display 6=Convert fields
7=Recompile files 8=Update files 9=Convert programs 10=Recompile programs...

   Conversion Description                                  Type    Progress

   XRAPPSCVCN Conversion for CUSNO field expansion         *ADD


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
Project added.
```

Figure 4-80 Work with X-Resize Conversions

Conducting recompile only exercise

At this stage, the X-Resize tool has identified what objects need be changed. Prior to converting the fields and applying any changes in the source code, you need to conduct a baseline test to establish whether any compile issues exist. This baseline test helps eliminate time wasted by trying to track down and resolves issues that existed previously and are not the result of the field expansion.

An example of this is a program that contains a reference to the expanded field (and thus was included in the build list), but cannot compile due to a missing logical file that it references. It could not be compiled prior to field expansion or afterwards. Any time spent trying to investigate and resolve this is beyond the scope of our field expansion effort.

To perform the baseline test:

1. Follow the steps described in “Setting up a conversion” on page 178 to create another X-Resize conversion (which we call XRAPPSTEST).
2. At the Work with X-Resize Conversions, select option 7 (Recompile files) next to the XRAPPSTEST conversion and press Enter (Figure 4-81).

```
X-Resize           Work with X-Resize Conversions            Databorough Ltd.
XRRWKCNV                                                             12:00:28
                                                                  15 Sep 2005
Enter options, press Enter.
1=Run complete conversion 2=Change 4=Delete 5=Display 6=Convert fields
7=Recompile files 8=Update files 9=Convert programs 10=Recompile programs...

   Conversion Description                                    Type    Progress

   XRAPPSCVCN Conversion for CUSNO field expansion            *ADD     Y Y Y Y
7  XRAPPSTEST Baseline test for XRAPPS conversion            *ADD


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
Project added.
```

Figure 4-81 Work with X-Resize Conversions

3. A job to recompile the files is submitted to batch. When this job completes, select option 10 (Recompile programs) next to the XRAPPSTEST conversion and press Enter.

   A job to recompile the programs is submitted to batch. As a result of the previous two steps, two physical files were created in library XRAPPSTEST:

   XRRCFERR Contains a list of all files that encountered errors during compilation and could not be compiled.

   XRRCVERR Contains a list of all programs that encountered errors during compilation and could not be compiled.

These activities produce a list of files and programs that could not be compiled prior to field conversion. You can use these two files later in the process to determine what files and programs to ignore when performing problem determination after an actual conversion.

Running field conversions and recompiling objects

With the conversion set up, you can convert the fields:

1. At the Work with X-Resize Conversions screen (Figure 4-82), select option 6 (Convert fields) next to the XRAPPSCVCN conversion and press Enter.

   The job XCVTFIELDS to convert the fields is submitted to batch. This job converts the field definitions in the source members for all of the identified database files. Monitor the progress of this job to verify that it completes successfully.

```
X-Resize           Work with X-Resize Conversions             Databorough Ltd.
XRRWKCNV                                                             16:22:22
                                                                  12 Sep 2005
Enter options, press Enter.
1=Run complete conversion 2=Change 4=Delete 5=Display 6=Convert fields
7=Recompile files 8=Update files 9=Convert programs 10=Recompile programs...

   Conversion Description                                          Type    Progress

6  XRAPPSCVCN Conversion for CUSNO field expansion                  *ADD
```

Figure 4-82 Work with X-Resize Conversions

2. When the batch job to convert the fields completes successfully, select option 7 (Recompile files) next to the XRAPPSTEST conversion and press Enter. A job to recompile the files is submitted to batch.
3. When the job to recompile the files, successfully completes, select option 9 (Convert programs) next to the XRAPPSTEST conversion (Figure 4-83) and press Enter.

```
 Submit Job (SBMJOB)

 Type choices, press Enter.

 Command to run . . . . . > XCVTPGMS XRLIB(XRAPPCUSNO) XA4LIB(XRAPPSGCX)
 CVLIB(XRAPPSCVCN) CVTTYPE(*ADD) NOTETYPE(*BOTH) NOTEVAL(XRSZE)

                                                                      ...
 Job name . . . . . > XCVTPGMS      Name, *JOBD
 Job description  . . . . . .   *USRPRF       Name, *USRPRF
   Library  . . . . . .                       Name, *LIBL, *CURLIB
 Job queue  . . . . . .   *JOBD         Name, *JOBD
   Library  . . . . . .                       Name, *LIBL, *CURLIB
 Job priority (on JOBQ) . . . . .   *JOBD         1-9, *JOBD
 Output priority (on OUTQ)  . . .   *JOBD         1-9, *JOBD
 Print device . . . . . .   *CURRENT      Name, *CURRENT, *USRPRF...
                                                                    More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 4-83 SBMJOB command prompt screen

4. The SBMJOB command prompt screen appears. Make sure your cursor is on the Command to run parameter and press F4.

5. The XCVTPGMS (Convert Programs) command prompt screen (Figure 4-84) appears. From here you can change the values of the Line Conversion Type and Annotation Type values that were discussed previously. In addition, you can change the Annotation Value parameter. This value marks converted source code. You can enter a value of your choice, or leave the default value of *DFT. If you specify *DFT, the system will use the value from data area XRMARGIN. Press Enter twice.

```
Convert Programs (XCVTPGMS)                Level: 2

Type choices, press Enter.

X-Resize Library . . . . . > XRAPPCUSNO    Name
X-Analysis Library . . . . . > XRAPPSGCX     Name, *XRLIB
Conversion Library . . . . . > XRAPPSCVCN    Name
Line Conversion Type . . . . . > *ADD          *ADD, *REPLACE
Annotation Type  . . . . . > *BOTH         *MARGIN, *COMMENT, *BOTH...
Annotation Value . . . . . .   *DFT          Name, *DFT

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 4-84 Convert Programs command prompt screen

6. A job to convert the programs fields is submitted to batch. This job converts the identified fields, variables, and other previously described constructs for all identified programs, modules, and any device files used by them. When the batch job to convert the programs has completed, select option 10 (Recompile programs) next to the XRAPPSTEST conversion and press Enter.

   A job to recompile the programs is submitted to batch.

Optional steps

If you are not using a change management system to implement the field re-engineering changes in production, you need to take the following two steps:

7. Update Files copies and maps the data from the original database files to the converted database files. Select option 8 (Update files) next to the XRAPPSTEST conversion and press Enter.

   A job is submitted to batch.

8. Reattach Triggers takes any trigger programs attached to the original database files and attaches them to the converted database files. Select option 11 (Reattach triggers) next to the XRAPPSTEST conversion and press Enter.

   A job to reattach the triggers is submitted to batch.

Performing analysis

After the conversion has completed, you are ready to analyze the results of the conversion. First you verify the changes were implemented by examining the source file member changes. You also want to verify that all files and programs were compiled successfully. In this section, you verify the results of the field conversion process by examining the source file member changes of a physical file, display file, and RPG program. And you analyze the log files to determine whether the files and programs compiled successfully.

Verifying completion of conversion process

To verify that the conversion process has completed, take the following steps:

1. At the Work with X-Resize Projects screen, select option `10` (Work with conversions) next to the XRAPPCUSNO project and press Enter.

   The Work with X-Resize Conversions screen (Figure 4-85) appears. Each conversion stage is displayed on the Work with X-Resize Conversions screen under the Progress columns (right column). If the stage has been completed, a Y appears in the column. Here is a description of each Progress column:

   – Progress column 1: Fields converted; the source file members of all affected files have been updated to reflect the field expansion.

   – Progress column 2: Files recompiled; all affected files have been recompiled.

   – Progress column 3: Files updated; the data of all affected database files has been copied and mapped from the original database files to the converted database files.

   – Progress column 4: Programs recompiled; all affected modules, programs, and service programs have been recompiled.

2. When all four Progress columns display `Y`, the conversion has completed.

```
X-Resize           Work with X-Resize Conversions            Databorough Ltd.
XRRWKCNV                                                             16:31:42
                                                                  12 Sep 2005
Enter options, press Enter.
1=Run complete conversion 2=Change 4=Delete 5=Display 6=Convert fields
7=Recompile files 8=Update files 9=Convert programs 10=Recompile programs...

   Conversion Description                                    Type    Progress

   XRAPPSCVCN Conversion for CUSNO field expansion            *ADD     Y Y Y Y


F1=Help  F3=Exit  F6=Add  F10=Cmd line  F12=Cancel  F24=More keys
```

Figure 4-85 Work with X-Resize Conversions screen

Verifying source code changes

As a result of the conversion process, changes were made to multiple source code members. In this section you verify some of the changes by examining the updated source file members of a physical file, display file, and RPG program.

To examine the DDS source file member changes to a physical file, perform the following steps:

1. From the Work with X-Resize Conversions screen, select option `12` (Work with conv. fields) next to the XRAPPSCVCN conversion and press Enter.

> **Tip:** If option 12 does not appear on the Work with X-Resize Conversions screen, press F23 (More options). Pressing the key shows additional list options on the display. The options can be used even when they are not shown on the display.

2. The Work with Members Using PDM screen appears (Figure 4-86). Select option 5 (Display) next to the CNTACS member and press Enter.

```
Work with Members Using PDM                RCHAS12

File  . . . . . .   QDDSSRC
  Library . . . .     XRAPPSCVCN           Position to  . . . . .

Type options, press Enter.
 2=Edit         3=Copy  4=Delete 5=Display       6=Print     7=Rename
 8=Display description  9=Save  13=Change text  14=Compile  15=Create module...

Opt  Member      Type        Text
5    CNTACS      PF          Contacts
     CNTCMAINTD  DSPF        Contacts Maintenance
     CUSF        PF          Sites
     CUSFMAINTD  DSPF        Customer Site Maintenance
     CUSFSELD    DSPF        Customer Site Selection
     CUSTS       PF          Purchases
     CUTMST      PF          Account Masters
     OE001DF     DSPF        Order Entry Display
                                                                      More...
Parameters or command
===>
F3=Exit          F4=Prompt             F5=Refresh            F6=Create
F9=Retrieve      F10=Command entry     F23=More options      F24=More keys
                                         (C) COPYRIGHT IBM CORP. 1981, 2003.
```

Figure 4-86 Work with Members using PDM screen

The Source Entry Utility (SEU) is invoked and the source file member CNTACS is presented in browse mode (Figure 4-87 on page 185). The following changes were implemented automatically by the conversion process:

- Line 3 contains a comment describing the change.
- Line 4 contains the specification for field CUSNO prior to the change. The length of the field is packed 5,0. This line has been commented out, instructing the compiler to ignore it.
- Line 5 has the new specification for CUSNO. The length of the field is now packed 7,0.

```
 Columns . . . :    1  71           Edit                    XRAPPSCVCN/QDDSSRC
 SEU==>                                                              CNTACS
 FMT A* .....A*. 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7
       *************** Beginning of data ************************************
0001.00       * Active Contacts File:
0002.00      A          R RCNTAC
0003.00 XRSZEA* Changed by X-RESIZE
0004.00 XRSZEA*           CUSNO          5P 0       TEXT('Cus. No.')
0005.00 XRSZEA            CUSNO          7P 0       TEXT('Cus. No.')
0006.00      A                                      COLHDG('Cus.' 'No.')
0007.00      A            USERNM        34A        TEXT('Contact')
0008.00      A            PRPCDE         2A        TEXT('Product Code')
0009.00      A                                      COLHDG('Prod' 'Code')
0010.00      A            TELNO         17A        TEXT('Phone')
0011.00      A            FAXNO         15A        TEXT('Fax.No.')
0012.00      A            EMAIL         50A        TEXT('Email')
0013.00      A            LCTDAT         6S 0      TEXT('Last Date')
0014.00      A                                      COLHDG('Last Cnt' 'Date')
0015.00      A                                      EDTCDE(Y)
0016.00      A            APDATE         6S 0      TEXT('Next Date')
```

Figure 4-87 SEU screen for CNTACS

3. Press F12 (Cancel) to return to the Work with Members Using PDM screen.

To examine the DDS source file member changes to a display file:

1. From the Work with Members Using PDM screen (Figure 4-88), select option 5 (Display) next to the CNTCMAINTD member and press Enter.

```
 Work with Members Using PDM                RCHAS12

 File  . . . . . .   QDDSSRC
   Library . . . .     XRAPPSCVCN          Position to  . . . . .

 Type options, press Enter.
  2=Edit         3=Copy  4=Delete 5=Display       6=Print     7=Rename
  8=Display description  9=Save  13=Change text  14=Compile  15=Create module...

 Opt  Member      Type        Text
      CNTACS      PF          Contacts
 5    CNTCMAINTD  DSPF        Contacts Maintenance
      CUSF        PF          Sites
      CUSFMAINTD  DSPF        Customer Site Maintenance
      CUSFSELD    DSPF        Customer Site Selection
      CUSTS       PF          Purchases
      CUTMST      PF          Account Masters
      OE001DF     DSPF        Order Entry Display
                                                                      More...
 Parameters or command
 ===>
 F3=Exit          F4=Prompt             F5=Refresh            F6=Create
 F9=Retrieve      F10=Command entry     F23=More options      F24=More keys
```

Figure 4-88 Work with Members Using PDM screen

2. SEU is invoked and the source file member CNTCMAINTD is presented in browse mode. Page down until you see the XRSZE tags (Figure 4-89). Note that the following changes were implemented automatically by the conversion process:
   - Line 2.5 contains the specification for field ZCUSNO prior to the change. The length of the field is packed 5,0. This line has been commented out, thus instructing the compiler to ignore it.
   - Line 2.6 contains a comment describing the change.
   - Line 2.7 contains the new specification for ZCUSNO. The length of the field is now packed 7,0.

   Press F12 (Cancel) to return to the Work with Members Using PDM screen.

```
 Columns . . . :    1  71           Browse                   XRAPPSCVCN/QDDSSRC
 SEU==>                                                          CNTCMAINTD
 FMT DP .....AAN01N02N03T.Name++++++RLen++TDpBLinPosFunctions++++++++++++++++++
0001.80      A                                     1 64'Databorough Ltd.'
0001.90      A                                         COLOR(BLU)
0002.00      A            ZZPGM         10A  O  2  2TEXT('Program Name')
0002.10      A                                         OVRDTA
0002.20      A                                     2 72TIME
0002.30      A            ZZDATE        11A  O  3 69OVRDTA
0002.40      A                                     4  2'Customer No . . . . . .'
0002.50 XRSZEA*           ZCUSNO         5Y 0B  4 28
0002.60       * XRSZE Line added by X-Resize
0002.70 XRSZEA            ZCUSNO         7Y 0B  4 28
0002.80      A                                         DSPATR(HI)
0002.90      A                                         OVRDTA OVRATR
0003.00      A  31                                     DSPATR(PR)
0003.10      A                                     5  2'Product Code  . . . . . .'
0003.20      A            ZPRPCDE        2A  B  5 28
0003.30      A                                         DSPATR(HI)
0003.40      A                                         OVRDTA OVRATR

 F3=Exit   F5=Refresh   F9=Retrieve   F10=Cursor   F11=Toggle   F12=Cancel
 F16=Repeat find        F24=More keys
```

Figure 4-89 SEU screen for CNTCMAINTD

Finally, to examine an RPG source file member change:

1. From the Work with Members Using PDM screen, change the value following File (the first input capable field on the screen, located in the top-left corner) from QDDSSRC to QRPGLESRC and press Enter.

2. The Work with Members Using PDM screen appears for the source file QRPGLESRC (Figure 4-90). Select option 5 (Display) next to the CNTCMAINT member and press Enter.

```
Work with Members Using PDM                RCHAS12

File  . . . . . .   QRPGLESRC
  Library . . . .     XRAPPSCVCN           Position to  . . . . .

Type options, press Enter.
 2=Edit         3=Copy  4=Delete 5=Display       6=Print     7=Rename
 8=Display description  9=Save  13=Change text  14=Compile  15=Create module...

Opt  Member      Type        Text
5    CNTCMAINT   RPGLE       Contacts Maintenance
     CUSFMAINT   RPGLE       Customer Site Maintenance
     CUSFSEL     RPGLE       Customer Site Selection
     WWCCONS     RPGLE       Work with Customer Contacts




                                                                      Bottom
Parameters or command
===>
F3=Exit          F4=Prompt             F5=Refresh            F6=Create
F9=Retrieve      F10=Command entry     F23=More options      F24=More keys
```

Figure 4-90 Work with Members Using PDM screen

3. The SEU screen is invoked and the RPGLE source file member CNTCMAINT appears in browse mode. Page down until you see the XRSZE tags (Figure 4-91). Note the following changes that were implemented automatically by the conversion process:
   - Line 1.7 contains the specification for field CUSTOMER prior to the change. The length of the field is packed 5,0. This line has been commented out, thus instructing the compiler to ignore it.
   - Line 1.8 contains a comment describing the change.
   - Line 1.9 contains the new specification for CUSTOMER. The length of the field is now packed 7,0.

   Press F12 (Cancel) to return to the Work with Members Using PDM screen.

```
 Columns . . . :    1  71          Browse                XRAPPSCVCN/QRPGLESRC
 SEU==>                                                          CNTCMAINT
 FMT *  ..... *. 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7
0001.60      D*****************************************************************
0001.70 XRSZED*customer        s              5p 0
0001.80       * XRSZE Line added by X-Resize
0001.90 XRSZED customer        s              7p 0
0002.00      D product         s              2a
0002.10
0002.20      D valid           s               n
0002.30      D errormsg        s            132a
0002.40      D msgid           s              7a
0002.50      D z1              s              5p 0
0002.60      D statuses        s              1a   dim(37) ctdata perrcd(37)
0002.70
0002.80      D zdate           ds            11
0002.90      D zday                           2a
0003.00      D filler1                        1a
0003.10      D zmth                           3a
0003.20      D filler2                        1a

 F3=Exit   F5=Refresh   F9=Retrieve   F10=Cursor   F11=Toggle   F12=Cancel
 F16=Repeat find        F24=More keys
```

Figure 4-91 SEU screen for CNTCMAINT

Analyzing recompiled objects

Recall that as a result of the steps to compile the files and the programs, two physical files were created in conversion library XRAPPSCVCN:

XRRCFERR Contains a list of all *files* that encountered errors during compilation and could not be compiled.

XRRCVERR Contains a list of all *programs* that encountered errors during compilation and could not be compiled.

Also recall that you performed these steps in another conversion library (XRAPPSTEST). This process provided the list of files and programs that could not be compiled prior to field conversion. Perform the following steps:

1. Examine the contents of file XRAPPSCVCN/XRRCFERR. If any files are listed in this log file, determine whether they also exist in log file XRAPPSCVCN/XRRCFERR. If so, you can probably ignore this particular file as the errors causing the compilation error likely existed prior to the conversion.

2. Do the same analysis for the program log file XRAPPSCVCN/XRRCVERR. Again, eliminate any programs that could not be compiled prior to conversion.
3. After you have completed this analysis, you should have a list of all files and programs that could not be compiled due to the conversion. More involved analysis is required at some point. Find and examine the spool files generated by the compile to determine the cause of the compilation errors.

4.6.7 Identifying potential problems

It is overly optimistic to expect the field re-engineering process to perform flawlessly, especially for large complex applications. This section covers some of the more common problems that occur during field re-engineering and introduces you to the reports that can help you identify and isolate the problems.

Device File Problems Report

During the conversion process of field re-engineering, the X-Analysis tool attempts to apply the conversion changes to the application's device files (display files and print files). In the case of field expansion, this means that more space is needed on the lines where the field appears. The tool uses a "shuffling" technique to shift everything (to the right of the field) over the appropriate number of columns. If it determines that the shift would move the contents of the line beyond the last available column of the device file, an error flag is set. The Device File Problems Report shows the cases where the shifting could not be applied due to the lack of device file columns necessary for the shift.

To print this report, take the following steps:

1. From the Work with X-Resize Projects screen, select option 12 (Print dev. file problems) next to the XRAPPCUSNO project and press Enter.
2. The job to print the report (XPRTDVPROB) is submitted to batch. To view the report from the Work with X-Resize Projects screen, press F16 (WRKSPLF).
3. The Work with All Spooled Files screen appears. Select option 5 (Display) next to the spool file entry with File name of XRREPORT and User Data of XRRPTDVP and press Enter.
4. The report is displayed (Figure 4-92). Press F12 (Cancel) twice to return to the Work with X-Resize Projects screen.

```
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8.
X-Resize    Device File Problems Report
XRRPTDVP

_____________________________________________________________________________
Member     File       Library    Format     Field      Problem
BTO3ODF    QDSPSRC    LIBBB      INVEXSSB   MOHINV     Extended field will ove
BTO3ODF    QDSPSRC    LIBBB      INVEXSSX   MOHINV     Extended field will ove

* * * * * E N D   O F   R E P O R T * * * * *
```

Figure 4-92 Device File Problems Report

Program Logic Problems Report

The Program Logic Problems Report shows the source lines with conversion problems. The problem might be due to the fact that a resized field (or a field dependent upon it) is a subfield in a structure that may not be resized.

1. From the Work with X-Resize Projects screen, select option 13 (Print program problems) next to the XRAPPCUSNO project and press Enter. The job to print the report (XPRTPGPROB) is submitted to batch. To view the report from the Work with X-Resize Projects screen, Press F16 (WRKSPLF).
2. The Work with All Spooled Files screen appears. Select option 5 (Display) next to the spool file entry with file name XRREPORT and User Data of XRRACPBS and press Enter.
3. The report is displayed (Figure 4-93). Press F12 (Cancel) twice to return to the Work with X-Resize Projects screen.

```
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8.
X-Resize    Program Logic Problems Report
XRRACPBS
*DETAIL,_SHOWFIXBLE(*NO),_SHOWTYPES(4),_ASSUMEFIX(*YES)_____________________________
Library    File       Member     Field      Type Source Statement
* * * * * E N D   O F   R E P O R T * * * * *
```

Figure 4-93 Program Logic Problems Report

DB Warnings Report

The Database Warnings report shows every source line where there may be a conversion problem. Example problems appearing in this report are:

- A resized field is moved to a non-resized field.
- Parameters that are work fields may not be resized.
- Resized and non-resized fields are compared.
- Key fields that are work fields may not be resized.
- Resized field (or a field dependent on it) is a subfield in a structure that may not be resized.

To run the report, follow these steps:

1. From the Work with X-Resize Projects screen, select option 14 (Print DB Warnings) next to the XRAPPCUSNO project and press Enter.

2. The command prompt screen for the OS/400 command SBMJOB appears (Figure 4-94). Make sure that the cursor is at the `Command to run` parameter and press F4 (Prompt).

```
 Submit Job (SBMJOB)

 Type choices, press Enter.

 Command to run . . . . . > XPRTUSAGE XRLIB(XRAPPCUSNO) XA4LIB(XRAPPSGCX
) RPTTYPE(*DBWARNING)

...
 Job name . . . . . > XPRTUSAGE     Name, *JOBD
 Job description  . . . . . .   *USRPRF       Name, *USRPRF
   Library  . . . . . .                       Name, *LIBL, *CURLIB
 Job queue  . . . . . .   *JOBD         Name, *JOBD
   Library  . . . . . .                       Name, *LIBL, *CURLIB
 Job priority (on JOBQ) . . . . .   *JOBD         1-9, *JOBD
 Output priority (on OUTQ)  . . .   *JOBD         1-9, *JOBD
 Print device . . . . . .   *CURRENT      Name, *CURRENT, *USRPRF...

                                                                    More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 4-94 Prompt screen for the SBMJOB command

3. The prompt screen for the Print Global Field Usage (XPRTUSAGE) command appears (Figure 4-95). Press F10 (Additional parameters).

   Additional parameters appear at the bottom of the prompt screen. We recommend that you do not change anything on this screen. The intent is to show you the parameters for the XPRTUSAGE command. Notice that the report type is *DBWARNING. The same XPRTUSAGE command can be used to generate various reports.

   Also notice the name and library of the output file. This is the file that contains the output records from the Build Global Field Usage (XBLDUSAGE) command.

4. Press Enter twice to submit the batch job to print the DB Warnings report.

```
 Print Global Field Usage (XPRTUSAGE)             Level: 2

Type choices, press Enter.

X-Resize Library . . . . . > XRAPPCUSNO    Name
X-Analysis Library . . . . . > XRAPPSGCX     Name, *XRLIB
Report type  . . . . . > *DBWARNING    *CHANGES, *WRKFLD...

                          Additional Parameters

Output file name . . . . . .   XRGWU         Name
Output Library . . . . . .   *XRLIB        Name, *XRLIB



                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 4-95 Prompt screen for the XPRTUSAGE command

5. The Work with X-Resize Projects screen appears. To view the report from the Work with X-Resize Projects screen, press F16 (WRKSPLF).
6. The Work with All Spooled Files screen appears. Select option 5 (Display) next to the spool file entry with File name XRREPORT2 and User Data of XRCPPGFU. Press Enter.
7. The report is displayed (Figure 4-96). Press F12 (Cancel) twice to return to the Work with X-Resize Projects screen.

```
X-Resize    DataBase Conflict Warnings Report
XRRPRGFU

File       Field      Description                                  Bytes     Positions Decimals
CUSF       ADD1       Address 1                                    00034        00        0
CUSF       PREFIX     Doc.Prefix:                                  00005        00        0
CUSTS      XWJUNO     Bank A/c                                     00008        15        0
SECF       SCDEXD     Xa Code Expiry Date                          00004        06        0
SECF       SSRLNB     Srl.no.                                      00008        00        0


F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 4-96 DataBase Conflict Warnings Report

Workfield Conflict Report

The Workfield Conflict Report shows the detection of workfield conflicts. A workfield conflict occurs when both of the following conditions occur:

- The references of a single workfield can be traced back to two or more database fields.
- At least one of those database fields is extended and at least one is not.

To print this report:

1. From the Work with X-Resize Projects screen, select option 15 (Print workfield conflicts) next to the XRAPPCUSNO project and press Enter.
2. The SBMJOB command prompt screen appears. Press F4 at the command to Run parameter to prompt the XPRTUSAGE command.
3. Do not change any of the parameter values. Press Enter twice to print the report.
4. The job to print the report (XPRTUSAGE) is submitted to batch. To view the report from the Work with X-Resize Projects screen, press F16 (WRKSPLF).
5. The Work with All Spooled Files screen appears. Select option **5** (Display) next to the spool file entry with File name of XRREPORT2 and User Data of XRCPPGFU and press Enter.
6. The report is displayed (Figure 4-97). Press F12 (Cancel) twice to return to the Work with X-Resize Projects screen.

```
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
X-Resize    Workfield Conflict Report: *WRKFLD
XRRPRGFU

Library    File       Member      Sequence Source Code
XRAPPSGC   QRPGSRC    WKSECF6     007900        C                     PARM CUSNO
```

Figure 4-97 Workfield conflict report

Source File References Report

The Source line References Report shows the total number of occurrences of each resized field in each program/module source member, with a grand total at the end of the report.

To print this report:

1. From the Work with X-Resize Projects screen, select option 16 (Print source refs) next to the XRAPPCUSNO project and press Enter.
2. The SBMJOB command prompt screen appears. Press F4 at the command to Run parameter to prompt the XPRTUSAGE command.
3. Do not change any of the parameter values. Press Enter twice to print the report.
4. The job to print the report (XPRTUSAGE) is submitted to batch. To view the report from the Work with X-Resize Projects screen, Press F16 (WRKSPLF).
5. The Work with All Spooled Files screen appears. Select option 5 (Display) next to the spool file entry with File name XRREPORT2 and User Data of XRCPPGFU. Press Enter.
6. The report is displayed (Figure 4-98). Press F12 (Cancel) twice to return to the Work with X-Resize Projects screen.

```
X-Resize    Program Source Line References Report: *CHANGES
XRRPRGFU

_____________________________________________________________________________________________________
Library    File       Member      Sequence Source Code
XRAPPSGC   QCLSRC     CLET        000200                DCL        VAR(&PK) TYPE(*CHAR) LEN(500)
XRAPPSGC   QCLSRC     CLET        000400                DCL        VAR(&CUSNO) TYPE(*DEC) LEN(5 0)
XRAPPSGC   QCLSRC     CLET        000500                DCL        VAR(&CUSNC) TYPE(*CHAR) LEN(5)
XRAPPSGC   QCLSRC     CLET        000600                DCL        VAR(&prefix) TYPE(*CHAR) LEN(5)
XRAPPSGC   QCLSRC     CLETN       000300                DCL        VAR(&CUSNO) TYPE(*DEC) LEN(5 0)
XRAPPSGC   QCLSRC     CLETN       000400                DCL        VAR(&PREFIX) TYPE(*CHAR) LEN(5)
XRAPPSGC   QCLSRC     CLETN       000700                DCL        VAR(&CUSNC) TYPE(*CHAR) LEN(5)
XRAPPSGC   QCLSRC     CPDM        000200                DCL        VAR(&PK) TYPE(*CHAR) LEN(500)
XRAPPSGC   QCLSRC     CPDM        000300                DCL        VAR(&CUSNO) TYPE(*DEC) LEN(5 0)
XRAPPSGC   QCLSRC     CPDM        000600                DCL        VAR(&CUSNC) TYPE(*CHAR) LEN(5)
XRAPPSGC   QCLSRC     CPDM        000700                DCL        VAR(&prefix) TYPE(*CHAR) LEN(5)
XRAPPSGC   QCLSRC     CUSFMAINTC  000200                DCL        VAR(&CUSTOMER) TYPE(*DEC) LEN(5 0)
XRAPPSGC   QCLSRC     CUSLET      000200                DCL        VAR(&CUSNN) TYPE(*DEC) LEN(5 0)
XRAPPSGC   QCLSRC     CUSLET      000300                DCL        VAR(&CUSNC) TYPE(*CHAR) LEN(5)
XRAPPSGC   QCLSRC     CUSLET1     000200                DCL        VAR(&PK) TYPE(*CHAR) LEN(500)
```

Figure 4-98 Print Source References Report

4.6.8 Import converted library into change management system

When you are satisfied with the results and you have verified that all necessary files and programs have compiled successfully after the field conversion, the converted library can be introduced to your testing environment. At this point the converted library should be imported into your change management system. The change management system is responsible for promoting the contents of the converted library through your testing, quality assurance, and production environments.

Each change management system is different and has its own interfaces, so a detailed example is not included. Most change management systems accept a library that contains the converted source code members. The converted library in our example, XRAPPCVCN, is what is input into the change management system. The change management system will compile the files and programs and promote them through the various environments. If configured to do so, it handles other complexities such as copying and mapping database file data, reattaching triggers, and re-enabling journalling.

5

Recovering application design

This chapter discusses how to recover application design models using X-Analysis. You will learn how to use the tool to build and explore a data model for your application and to break the application up into logical functional areas. You will discover how X-Analysis can help you visualize the program structure of your systems and how you can separate your business rules from screen and database handling.

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5.1 Modernization and maintenance through modelling

In some cases modernizing your existing applications may not be a straight conversion exercise. You might want to rework it to utilize the full capabilities of modern ILE RPG. The application that is created by the X-Analysis conversion might not fit your needs or your architecture. In this scenario you need to build a deeper understanding of your applications to help with the re-engineering process. To accomplish this, the first stage is to construct a model of the existing application.

An accurate model of your existing system can also help to improve its maintainability. Organizations are exposed to risks when they lack an understanding of their existing applications. The original designers and developers of the software may have left the organization. Design documentation may be incomplete, inaccurate, or simply missing. People supporting or updating the application often have a shallow understanding of the code. This can make support, maintenance, and enhancement of applications problematic, more time consuming, and more expensive than is necessary. X-Analysis can help recover the application design and make it quicker and easier to understand these applications.

5.2 Recovering the data model design

In the past, the DB2 database did not offer the means to describe relationships between tables such as foreign key constraints. As a result, relationships existed and were enforced purely in the logic of existing applications. Relationships may not be as simple as foreign keys, and other relationships may be embedded even deeper into application logic. For example, a transaction type code held on a control table may form a part of a transaction number field on a historical table. There is an implicit relationship between these two tables.

X-Analysis can help identify these relationships and recover a data model design. It analyzes an application and builds a data model that you can visualize through the X-Analysis client or export into other case tools. It also produces a set of function definitions that you can run as a prototype application through X-Browse.

The main command used in this process is XDMODEL. This command generates the data model for the target application or application area. (See 5.3, “Application areas” on page 197 for more information about application areas.)

Note: You must have the X-Rev extension to X-Analysis to perform data modelling. X-Rev commands are located in the library XREV.

5.2.1 Tuning the data model with XDMODEL

The XDMODEL command has several key parameters that enable you to control and tune how the relationships in the data model are built.

- FORGNKEYS (Derive foreign keys) specifies how foreign keys are determined. This can be a combination of database and program logic or using an existing Synon data model.
- MATCHVAL (Allow unmatched fieldnames) specifies how closely fieldnames must match when validating a relationship.
- EXCLIND (Exclude indirect relations) is an option used to simplify the generated model by removing indirect relationships. For example, if there is a grandparent > parent > child relationship between three tables, then using this option will exclude the implicit grandparent > child relationship from the data model.

- VALPGREF (Validate relations by program references) only allows relationships to be generated when they can be proved by program logic.
- OWNERSIM (Priority to simplest owner) is an option used to simplify the generated model by including only the simplest relationship when multiple relationships are identified.
- ONETOONE (Derive 1 to 1 relationships) allows the inclusion or exclusion of “extends by” relationships in the model.

5.3 Application areas

Large applications can be subdivided into smaller units containing a subset of the overall functionality. When broken up into more manageable pieces, these smaller units are clearer and easier to understand than the system as a whole. X-Analysis offers the facility to create these smaller units, which are known as *application areas*. If the diagrams for your system are complex and difficult to read, breaking the system down into application areas can make the diagrams much easier to follow.

5.4 Defining application areas

You define and maintain application areas using either the X-Analysis client or OS/400 commands. We use the X-Analysis client to define a new application area within our example Customer Management System (CMS). In this example, the application library XRAPPSXA holds the CMS model.

1. Right-click the application library node and select **New Application Area** (Figure 5-1).

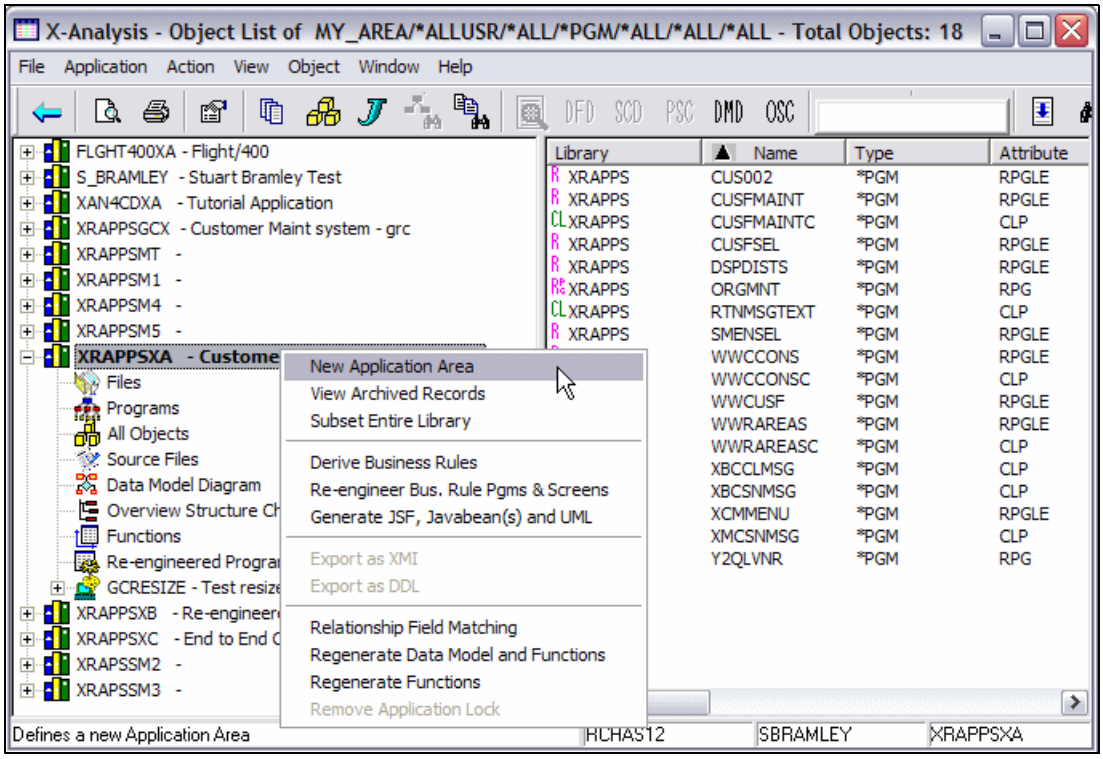

Figure 5-1 Adding a new application area

X-Analysis prompts you to enter a name and a description for the new application area (Figure 5-2). Enter `MAIN_MENU` as the name of the new application area and `Customer Management System Menu` as the description.

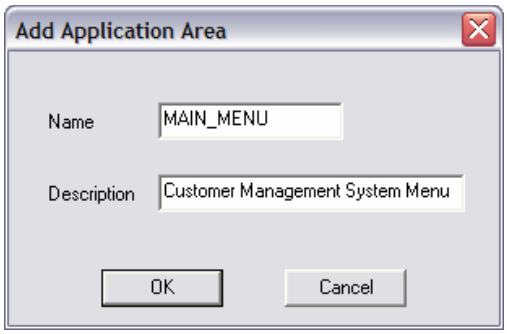

Figure 5-2 Add application area dialog

The application area is defined and appears as a new node under the application library (Figure 5-3). Notice that the expanded application area node has the same set of nodes underneath it as the application library (with the exception of application area nodes).

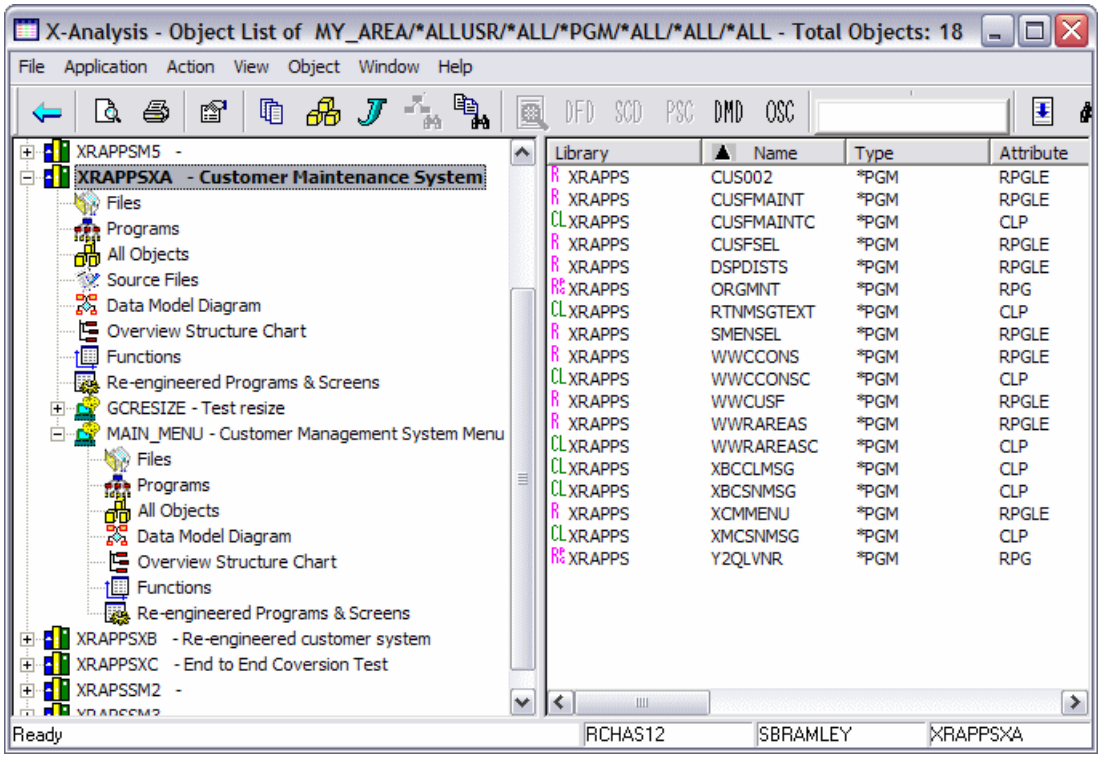

Figure 5-3 The new application area node

2. An application area was created but it does not contain any objects. To add everything that is in the call stack from Customers Main Menu into our MAIN_MENU application area (Figure 5-4), perform the following steps:

   a. Double-click the **Programs** node under the application library.

   b. Click **OK** in the Work With Objects dialog. X-Analysis displays a list of all programs in the application library.

   c. The Customers Main Menu program is called XCMMENU. Locate this program in the list and right-click it to display the context menu.

   d. Select **Add to Application Area with Related Objects**.

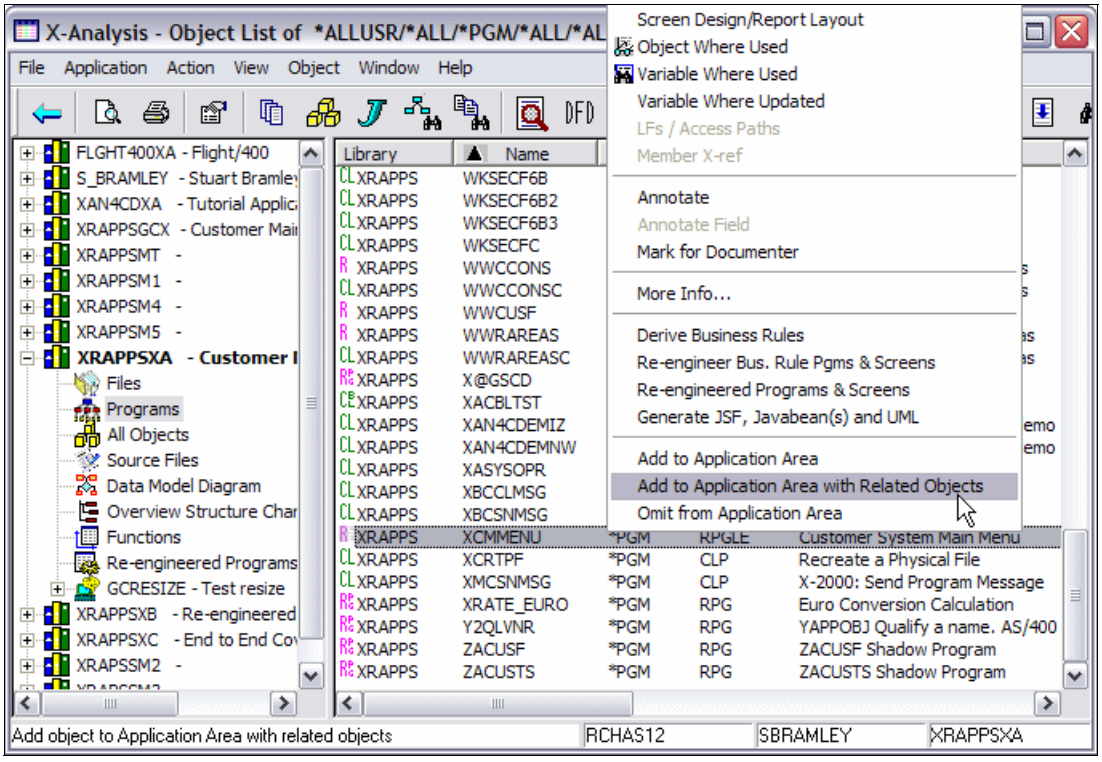

Figure 5-4 The program context menu

3. Specify to X-Analysis which application area to add the object into, and what related objects it should add in alongside it (Figure 5-5). We want to add any files that this program uses, anything that can be called from this program, and any files that are used by those programs:
   a. Select MAIN_MENU from the list of application areas to specify the application area.
   b. Select **Include files referenced by this program** to specify all files this program uses in any way to the application area.
   c. Select **Include complete stack of programs called** to include any programs called by this program (and any programs that they in turn call) in the application area.
   d. Select **Include files referenced by any included program** to add all files that any of the included programs reference in any way to the application area.
   e. Click **OK**.

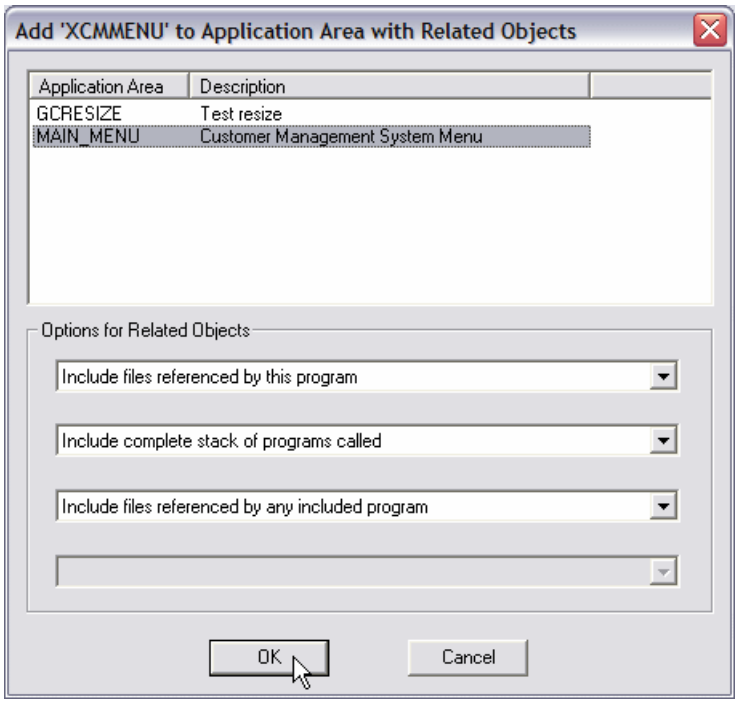

Figure 5-5 Adding an object to an application area with related objects

5.5 Exploring the application data model

X-Analysis enables you to explore the data model for your application or application area through the Data Model Diagram (DMD) view.

1. Expand the newly created MAIN_MENU application area node, and double-click the **Data Model Diagram** node.

2. This brings up the **Data Modelling Diagram** dialog (Figure 5-6). This dialog enables you to filter the objects that are displayed in the diagram and force X-Analysis to regenerate the diagram data. As you open the dialog from the application area's node, the application area defaults to MAIN_MENU. Click **OK** to accept the defaults.

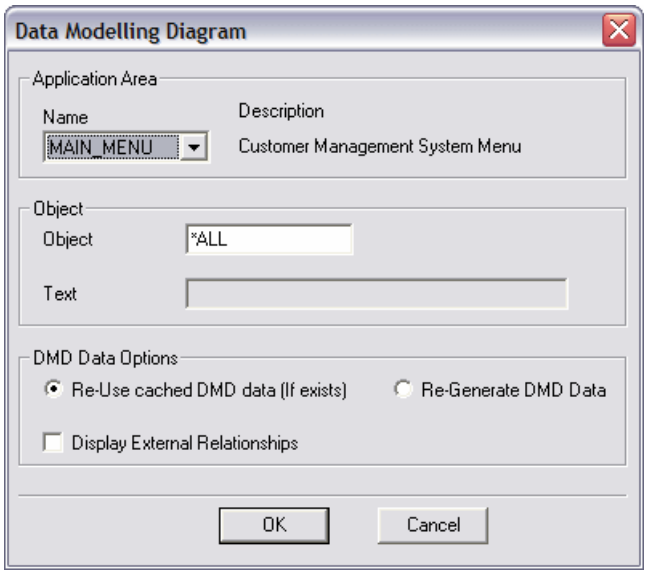

Figure 5-6 Data Modelling Diagram dialog

3. The DMD for the MAIN_MENU application area is displayed (Figure 5-7). By default X-Analysis shows all of the relationships between tables.

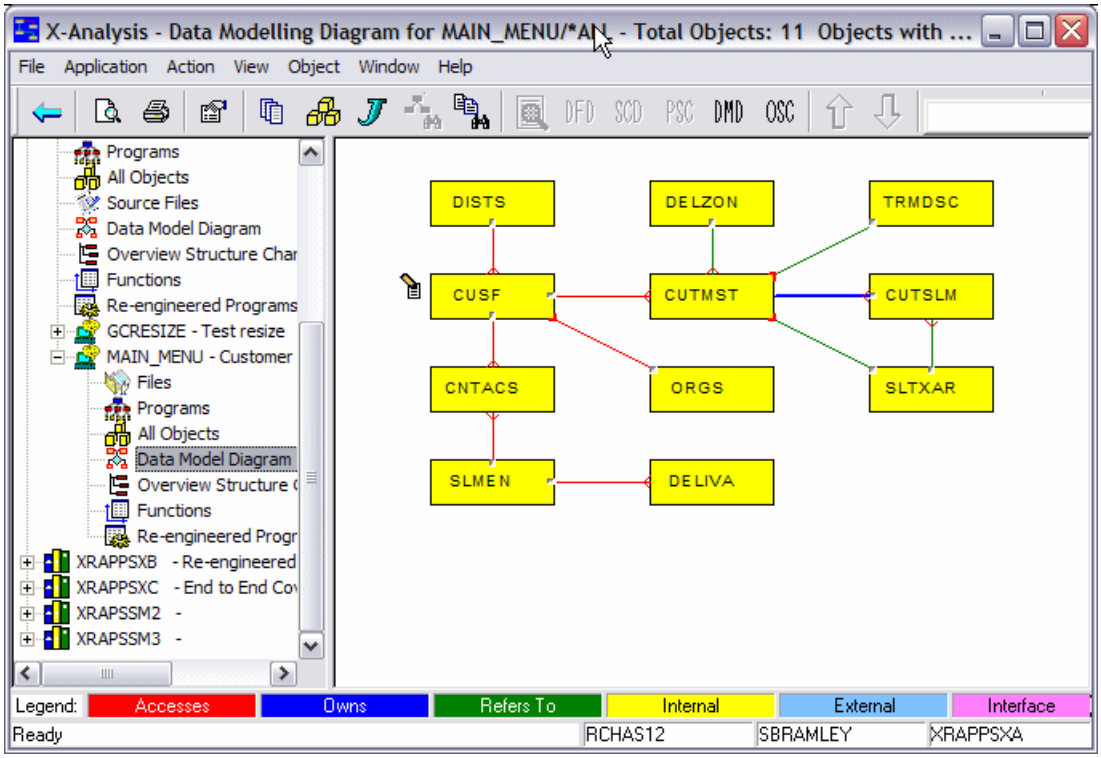

Figure 5-7 The data modelling diagram for an application area

Three types of relationships are presented in the X-Analysis data model:

Owns Describes a direct parent-child relationship. The primary key of the parent file forms the first part of the primary key of the child.

Refers To Describes a foreign key relationship. Fields on the dependent file can be used as the primary key to the owning file. In this scenario it is not possible to access a record from the dependent file from the owning file.

Accesses Is a stronger form of the Refers To relationship. There is an access path over the dependent file that can be accessed by the foreign key.

And three types of files are presented in the X-Analysis data model:

Internal Files located inside the application area.

External Files located outside the application area.

Interface Is an interface to a completely different application or system.

4. You can choose to view relationships with tables outside of the current application area in your DMD. To do this, select **Display External Relationships** in the Data Modelling Diagram dialog (Figure 5-6 on page 201) when generating the DMD. The tables external to the current application area are displayed in blue in the DMD (Figure 5-8).

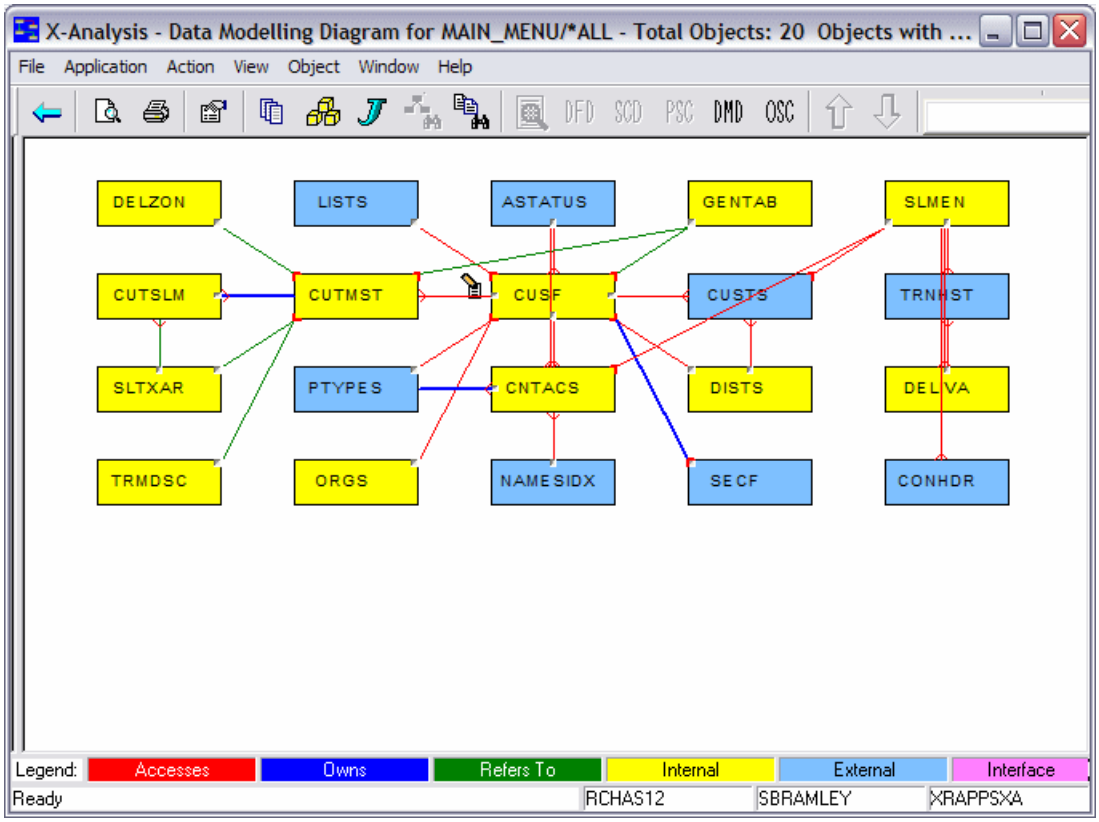

Figure 5-8 Data modelling diagram including external relationships

5. The DMD is an interactive diagram that enables you to explore the application data model. To view the relationships for a single table rather than the entire model, you simply click on that table. Click on the table **CUTMST** in the diagram (see Figure 5-9).

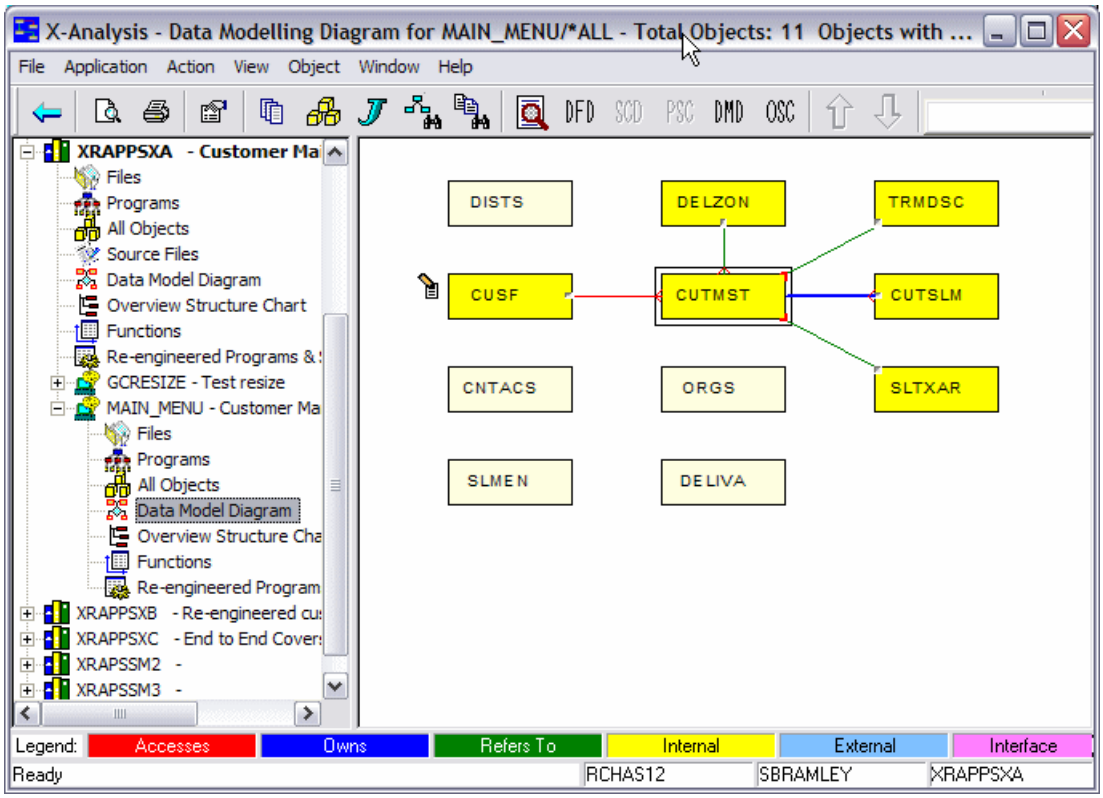

Figure 5-9 Data modelling diagram showing relationships to a single table

6. On each relationship link is a small button. This enables you to display the fields that are involved in that relationship (Figure 5-10). Click the button on the CUSF relationship to CUTMST to view the details of the connection between these two tables.

> **Tip:** A relationship link is the line between two tables. The button is at the end of this line where it meets the child table.

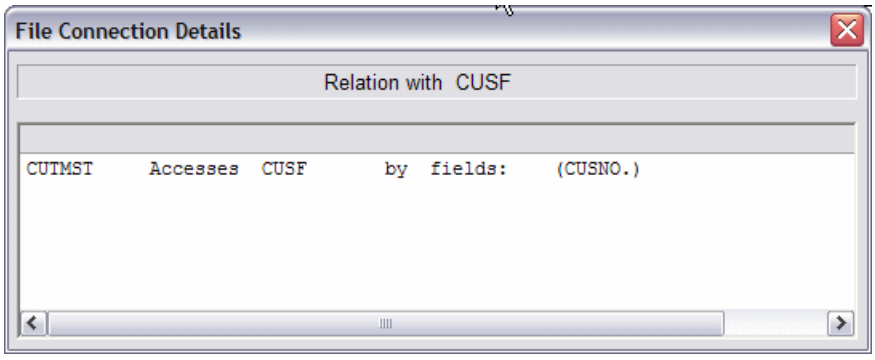

Figure 5-10 File connection details dialog

7. You can view all of the information for a single table by drilling down into the detailed DMD view. Double-click the **CUTMST** table to view its detailed DMD (Figure 5-11).

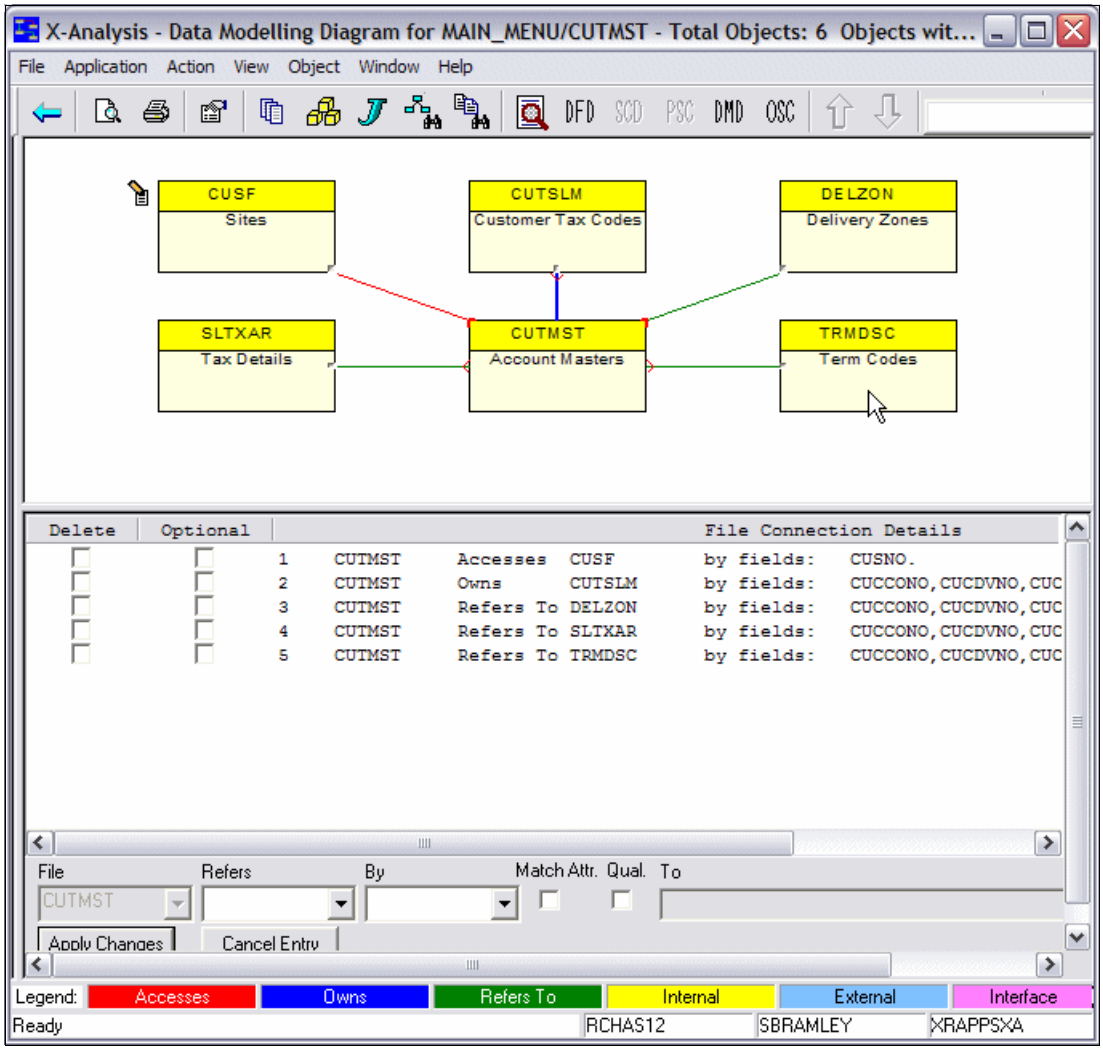

Figure 5-11 Detailed data modelling diagram view (Note: the navigation panel has been minimized)

8. Click any table in the detailed DMD view to display only the relationship between that table and the primary table in the diagram. Click the table **CUTSLM** to show the relationship with CUTMST(Figure 5-12). You can see that CUTMST owns (is a parent of) the file CUTSLM.

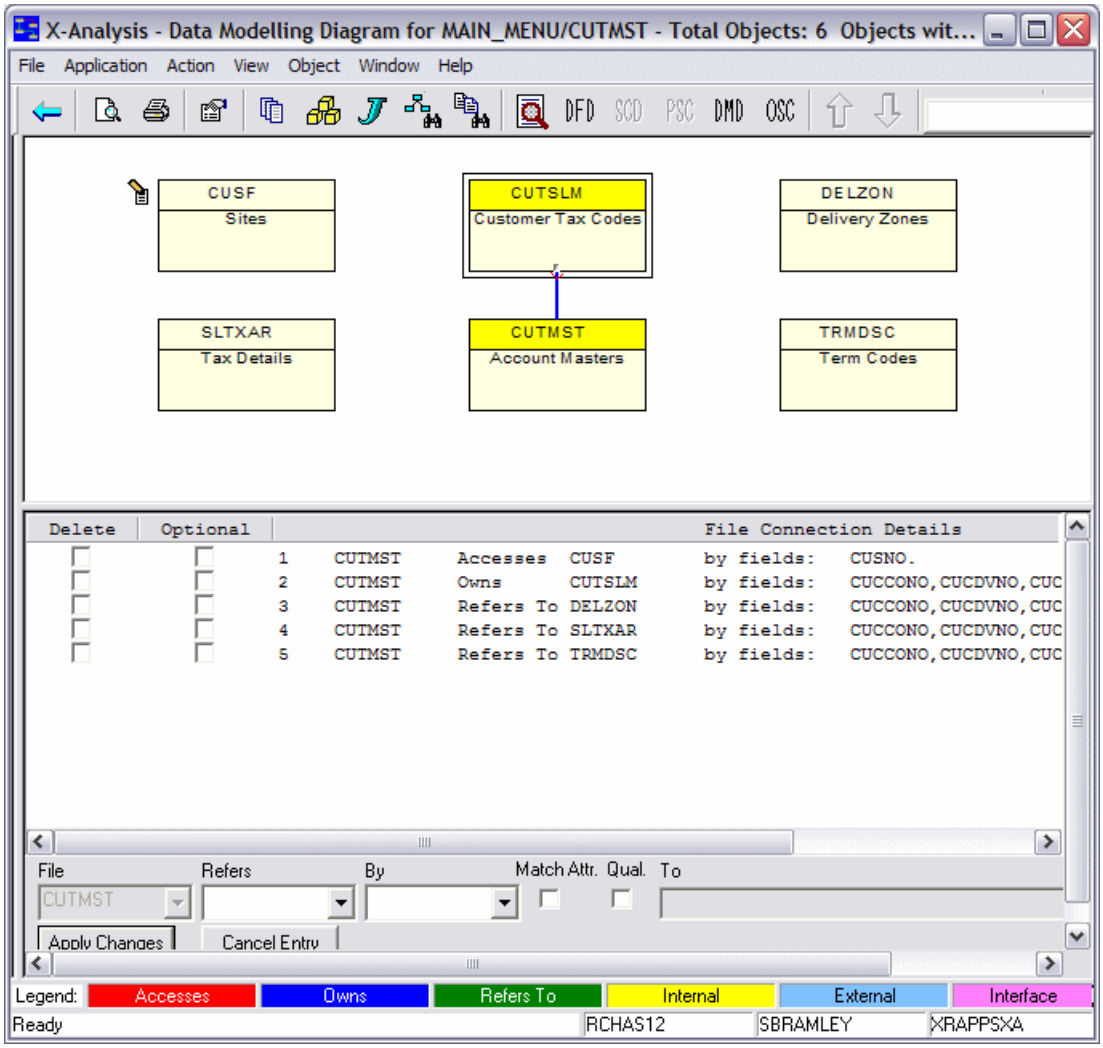

Figure 5-12 Detailed data modelling diagram showing relationship to a single table

5.5.1 Adjusting the generated data model

In certain scenarios it is possible that the information in the data model requires some manual adjustment. This can occur if:

- The data model is not built with the appropriate parameters for your site or for a subset of your application.
- The application logic does not enable the modelling process to determine the information automatically.

In this situation you can manually adjust the data model by adding overrides. You can add or delete relationships, including complex relationships between fields that do not necessarily have the same data type.

An example of a need for an override exists in the CMS system. The Sites file CUSF should have a relationship with the Salespersons file SLMEN. The field SINIT on CUSF should logically join to the PERSON field on SLMEN. However, the CMS application is incomplete and does not contain the program logic to enable X-Analysis to determine this relationship automatically. Therefore, we manually adjust the data model to add this relationship by taking the following steps:

1. Ensure that the application library is set to allow interactive update. This is controlled by the data area XINTUPD in the application library on the iSeries server. To allow interactive update, you must set the value of this to *YES.
2. Open the application area node in the X-Analysis client navigation pane. In this example, the application library is XRAPPSSB.
3. Expand the MAIN_MENU application area node created previously. This contains a subset of the application, and the diagrams are simpler to work with.
4. Double-click **Data Model Diagram**.
5. Click **OK** in the Data Modelling Diagram dialog.
6. Double-click the **CUSF** file in the diagram to view its detailed DMD.
7. If interactive update was enabled correctly, the panel in Figure 5-13 will be displayed at the bottom of the DMD.

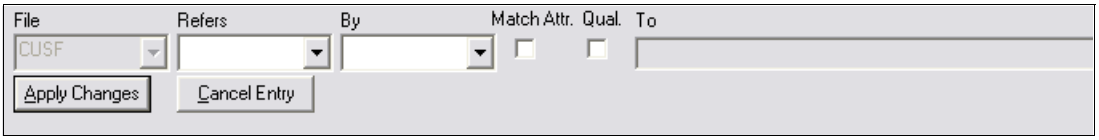

Figure 5-13 Interactive update panel

> **Tip:** You may need to resize the frames in the detailed DMD to see this panel. If it is not visible, drag the horizontal divide upwards to make the bottom section bigger.

8. To add the relationship to SLMEN in this panel:
   a. Select **SLMEN** in the Refers list.
   b. Select **SINIT** in the By list.
   c. Click **Apply Changes**.

   The detailed DMD is updated and the relationship with SLMEN appears (Figure 5-14 on page 207).

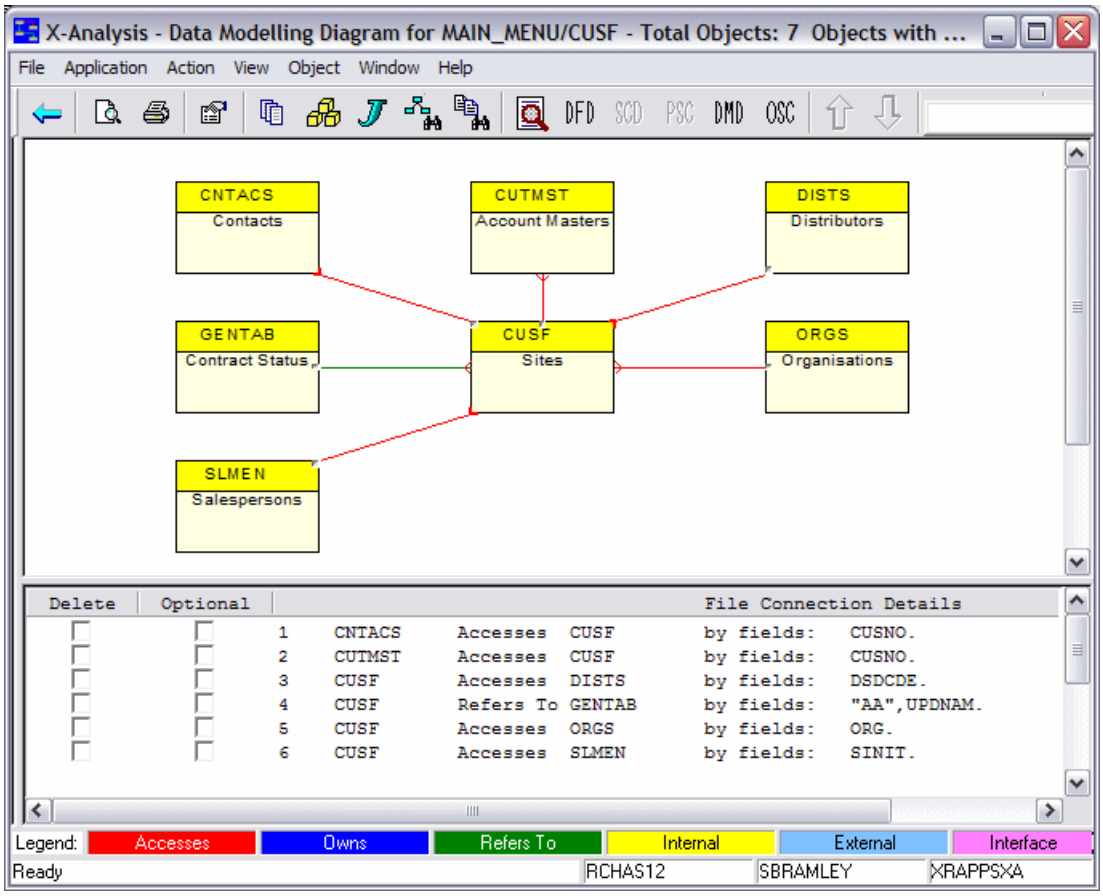

Figure 5-14 Detailed DMD for CUSF with added relationship to SLMEN

The override that you have added stays in place even when the data model is rebuilt. This facility enables you to perfect the data model that X-Analysis built.

5.6 Exploring the data in the database

X-Analysis enables you to view data in your database directly from the data model.

1. Select the CUSF file in the data model. Click the View data icon in the tool bar. The X-Browse window appears (Figure 5-15).

> **Note:** You must have the X-Browse extension to X-Analysis installed to view data.

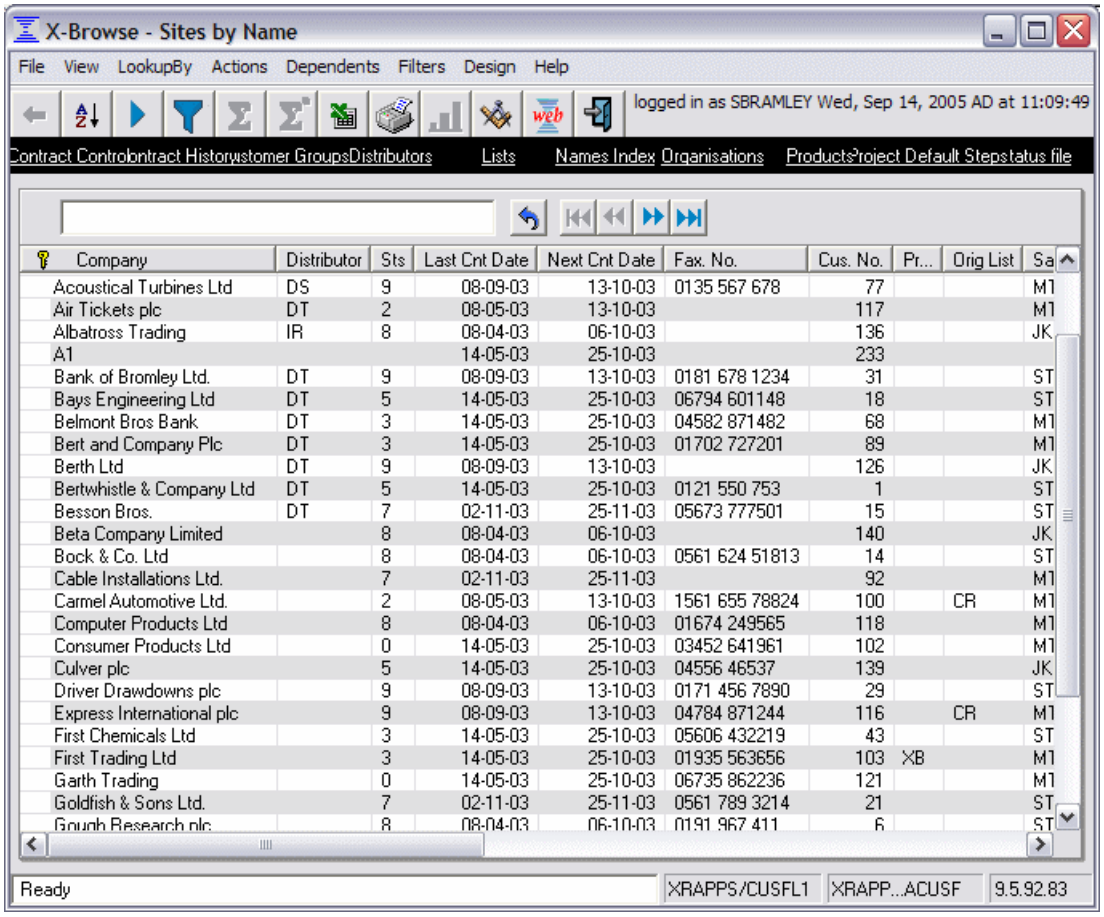
X-Browse - Sites by Name
File View LookupBy Actions Dependents Filters Design Help
logged in as SBRAMLEY Wed, Sep 14, 2005 AD at 11:09:49
Contract Controlontract Historystomer GroupsDistributors Lists Names Index Organisations Productsroject Default Stepstatus file
Company Distributor Sts Last Cnt Date Next Cnt Date Fax. No. Cus. No. Pr... Orig List Sa
Acoustical Turbines Ltd DS 9 08-09-03 13-10-03 0135 567 678 77 M1
Air Tickets plc DT 2 08-05-03 13-10-03 117 M1
Albatross Trading IR 8 08-04-03 06-10-03 136 JK
A1 14-05-03 25-10-03 233
Bank of Bromley Ltd. DT 9 08-09-03 13-10-03 0181 678 1234 31 ST
Bays Engineering Ltd DT 5 14-05-03 25-10-03 06794 601148 18 ST
Belmont Bros Bank DT 3 14-05-03 25-10-03 04582 871482 68 M1
Bert and Company Plc DT 3 14-05-03 25-10-03 01702 727201 89 M1
Berth Ltd DT 9 08-09-03 13-10-03 126 JK
Bertwhistle & Company Ltd DT 5 14-05-03 25-10-03 0121 550 753 1 ST
Besson Bros. DT 7 02-11-03 25-11-03 05673 777501 15 ST
Beta Company Limited 8 08-04-03 06-10-03 140 JK
Bock & Co. Ltd 8 08-04-03 06-10-03 0561 624 51813 14 ST
Cable Installations Ltd. 7 02-11-03 25-11-03 92 M1
Carmel Automotive Ltd. 2 08-05-03 13-10-03 1561 655 78824 100 CR M1
Computer Products Ltd 8 08-04-03 06-10-03 01674 249565 118 M1
Consumer Products Ltd 0 14-05-03 25-10-03 03452 641961 102 M1
Culver plc 5 14-05-03 25-10-03 04556 46537 139 JK
Driver Drawdowns plc 9 08-09-03 13-10-03 0171 456 7890 29 ST
Express International plc 9 08-09-03 13-10-03 04784 871244 116 CR M1
First Chemicals Ltd 3 14-05-03 25-10-03 05606 432219 43 ST
First Trading Ltd 3 14-05-03 25-10-03 01935 563656 103 XB M1
Garth Trading 0 14-05-03 25-10-03 06735 862236 121 M1
Goldfish & Sons Ltd. 7 02-11-03 25-11-03 0561 789 3214 21 ST
Gough Research plc 8 08-04-03 06-10-03 0191 967 411 6 ST
Ready
XRAPPS/CUSFL1
XRAPP...ACUSF
9.5.92.83

Figure 5-15 Viewing the data in the CUSF file in X-Browse

2. You can perform drill-down inquiries by double-clicking any record in the display. X-Analysis uses the data model that it has built to include all related data items on this display. Double-click the record for **Bertwhistle & Company Ltd** to view this site's record (Figure 5-16 on page 209).

3. Notice that the value in the Distributor field is displayed both as the value held on the table and the name of the distributor as held on the DISTS file. X-Analysis identifies the relationship between this field and the primary key of the DISTS file. It also identifies a *descriptor* field for the DISTS file. This field describes the information held in the record (for example, a name or description field). It uses the foreign key value to retrieve the descriptor field from that file.

   To view the possible descriptor field values, click the less-than sign (**<**) by the Distributor field.

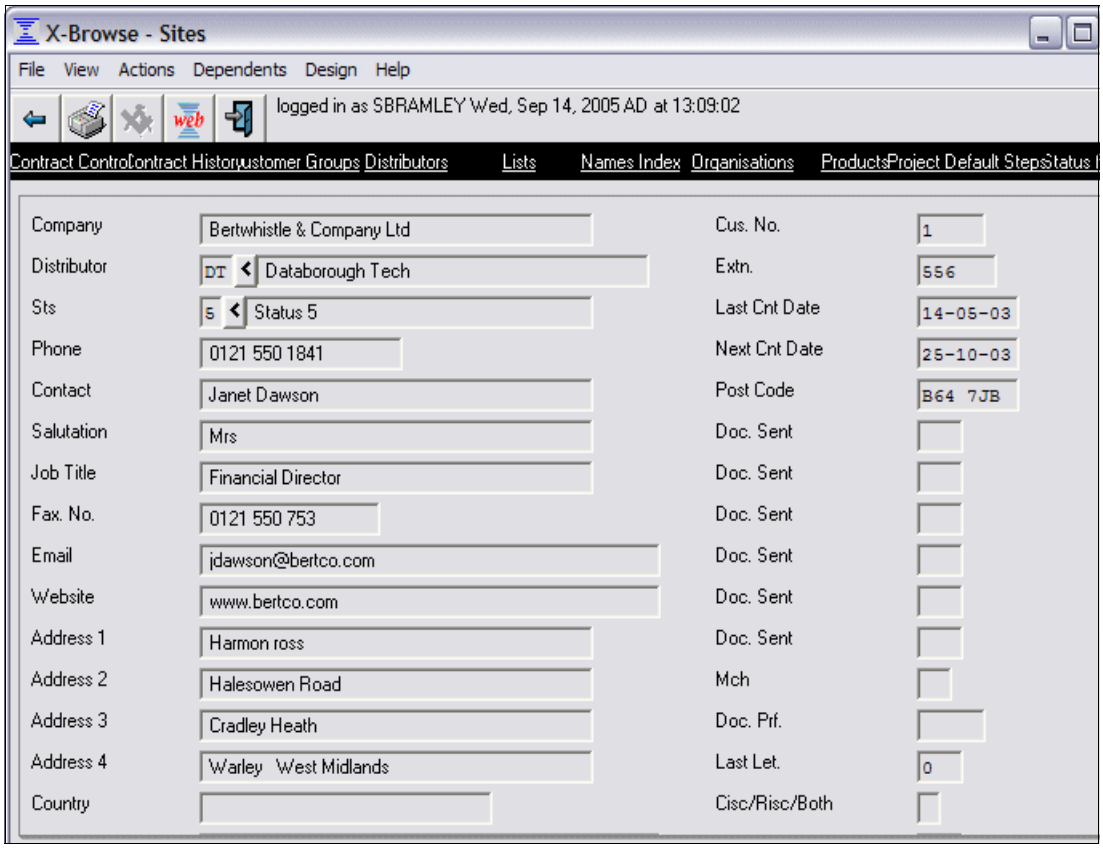

Figure 5-16 Viewing a record in X-Browse

4. Select the record with the code DT and click **Display** (Figure 5-17).

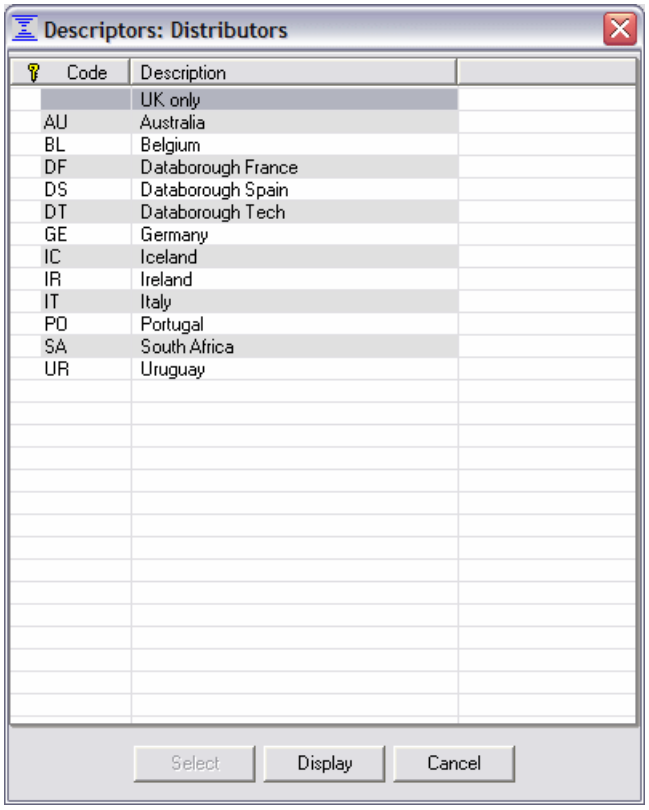

Figure 5-17 Descriptor fields for the Distributors table

5. You see the record displayed in a new X-Browse window. You can also view the related records on dependent tables. In the X-Browse window for the Sites (CUSF) file, click **View** → **Dependent Functions**.
6. A series of tabs appears (Figure 5-18). Open the **Purchases** tab.

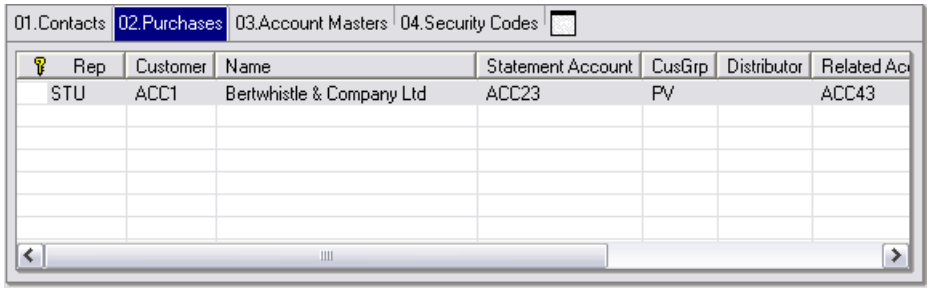

Figure 5-18 Viewing dependent record data

The data from the dependent files is displayed, but only data that is related to the record in the main display. In this case you can display all purchase records for Bertwhistle & Company Ltd. Double-click this record to drill down into the purchase record and display it in the X-Browse window.

5.7 Measuring referential integrity

Referential integrity may not be enforced at the database level. This may be by design or due to the application pre-dating referential integrity features in the database. X-Analysis can produce an exception report by applying the reverse-engineered rules to the data in the database.

The command to run this report is XVERIFY (Figure 5-19).

```
                    Data Integrity Verification (XVERIFY)

Type choices, press Enter.

X-Rev function library . . . . .               Name
Database library name  . . . . .   *LOADLIB     Name, *LOADLIB, *LIBL
X-Analysis application area  . .   *ALL         Name, *ALL
Run mode . . . . . . . . . . . .   *REPORT      *REPORT, *UPDATE, *PREUPDATE
Maximum Errors Allowed . . . . .   5            1-999, *NOMAX, *NONE
Maximum Records to Search  . . .   *ALL         1-999999999, *ALL, *NONE



                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 5-19 The XVERIFY command

Table 5-1 XVERIFY command parameters

Parameter	Special values	Description
X-Rev function library (FUNLIB)		The library that contains the data model
Database library name (DBLIB)	*LOADLIB: Use the database library that files were located in when the database was modelled. *LIBL: Use the current library list to locate files.	The library that contains the database to report over
X-Analysis application area (XA4AREA)	*ALL: Report over the complete data model.	Enables the report to be restricted to one application area
Run mode (MODE)	*REPORT: Prints a report showing referential integrity failures (see below). *UPDATE: Updates the database model to downgrade or delete the relationship between files if more errors are found than the number specified in the MAXRECS parameter. *PREUPDATE: Reports on the changes that would be made in *UPDATE mode without actually making those changes	Governs what mode X-Verify runs in (see special values)

Parameter	Special values	Description
Maximum Errors Allowed (MAXRECS)	*NONE: No errors are allowed. *NOMAX: There is no maximum number of errors allowed	If MODE is *REPORT, this specifies the maximum number of entries that will appear on the report. If MODE is *UPDATE, this specifies the threshold number of errors that are allowed before a relationship will be downgraded or deleted.
Maximum Records to Search (MAXDBRECS)	*ALL: All records will be examined. *NONE: No records will be examined.	Specifies the maximum number of records in each file that will be examined.
X-Analysis library (XA4LIB)		If an application area is specified, the X-Analysis library containing the application area is required.

Use this command to determine how clean your production data is and to fine-tune the data model that X-Analysis generates. The report contains details of each relationship that the command verifies. It tells whether the data was verified successfully; if not, it tells you the key to the record on the parent table that is invalid and the key that cannot be found on the child.

If there are a large number of failures for a relationship then the relationship may be incorrect. Running the command with MODE(*UPDATE) can automatically do some of this fine-tuning for you. If a greater number of errors occurs than you specify on the MAXRECS parameter, then the relationship will be downgraded to a Refers To relationship. If it is already a Refers To relationship then it will be deleted from the model.

5.8 Recovering application design structure

In order to understand the existing application, it is vital to understand the function of the various programs within it and the way they interrelate. X-Analysis provides a means of graphically displaying an overview of an application or application area to help you gain this understanding. The Overview Structure Chart (OSC) shows you the hierarchy of programs in the application or application area. Entry points to the application are displayed at the top of the hierarchy - these are the top-level programs that are not called from any other program in the application or application area. Each program is colored to indicate its general function. To view the OSC for the MAIN_MENU application area, take the following steps:

1. Expand the **MAIN_MENU** node in the navigation pane and double-click **Overview Structure Chart**.

2. The Overview Structure Chart dialog is displayed (Figure 5-20). The application area is defaulted to the MAIN_MENU, click **OK** to accept the defaults.

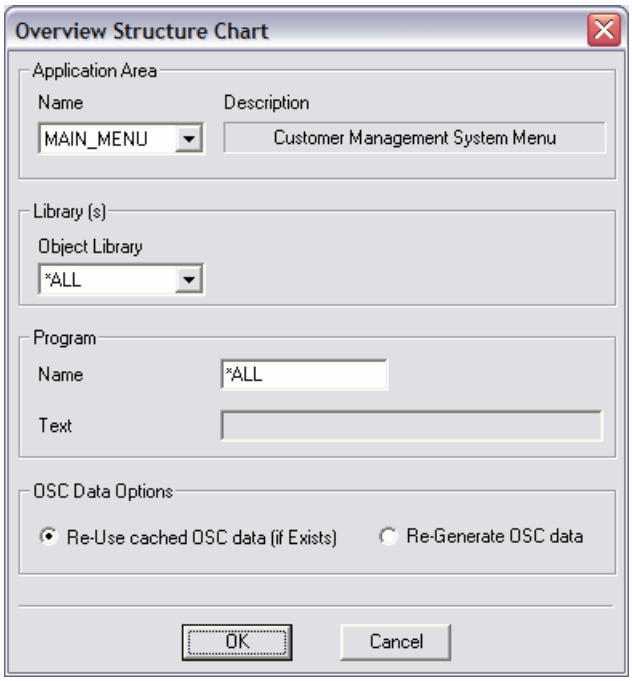

Figure 5-20 The overview structure chart dialog

The OSC for the application area is displayed (Figure 5-21 on page 214).

The entry point in the application area is the program XCMMENU - Customers Main Menu. This program was used to build the application area. X-Analysis categorizes the programs by color according to the general function that they perform. These functions relate to how the programs interact with the database. The possibilities are:

Update	The program updates data in the database.
Display	The program displays data from the database.
Print	The program produces a report of the data from the database.
Input	The program reads data from the database.
Output	The program writes new data to the database.
Command	The object referenced is a command.
Others	The program does not use the database.
Indeterminate	X-Analysis could not analyze the object, usually because it is outside the application library.
Trigger	The program is a database trigger program.

XCMMENU has been categorized as Others because it performs no database access.

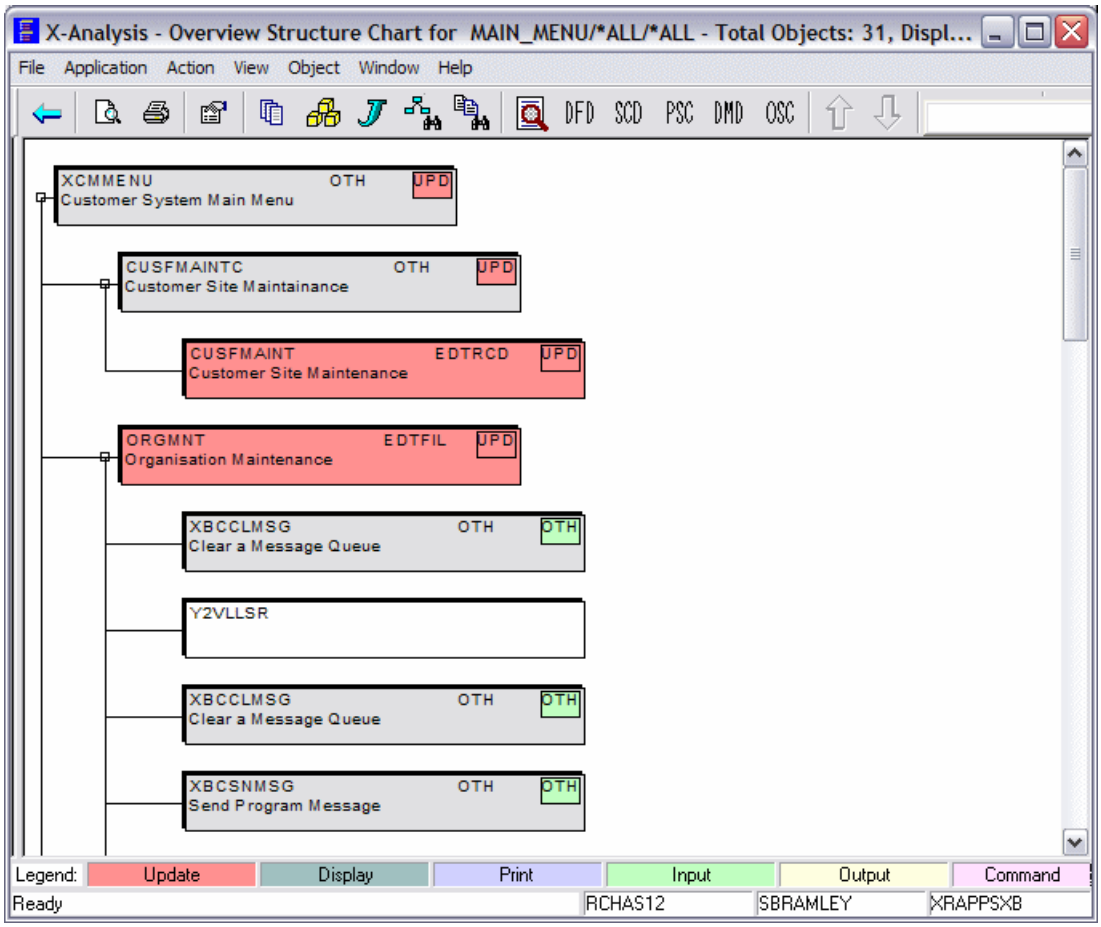

Figure 5-21 The overview structure chart

The box in the top-right corner of each program rectangle describes the *rolled up* function of the program. Each type of function has a place in a hierarchy according to the strength of its interaction with the database. This box represents the strongest function that is in the stack of programs called. For example, in Figure 5-21, XCMMENU has a red update box because update functions are in the stack of programs that it calls.

You can use the OSC diagram to drill down and analyze the individual programs using the tools described starting in 4.3, “Application analysis and documentation” on page 124. These tools can help complete your understanding of the application.

5.9 Recovering business rules

Some of the most valuable artifacts in your existing applications are the business rules that are coded into them. Very often these applications were not developed in a modular fashion; the programs perform multiple functions such as database access, screen handling, application workflow, or business logic. If business logic is embedded in a screen program it cannot be accessed by any other programs. If the same business rules should be applied elsewhere, they have to be duplicated, which increases the maintenance overhead if the logic has to change in the future.

One goal when designing a component-based architecture is for each component in a system to perform one clearly defined task. To move an existing application toward this kind of

architecture, you must identify the different types of processing in the application. This helps you identify any modular code that can be reused and code that must be restructured to move processing into more functionally cohesive components.

In our example Customer Management System, there is a screen-based customer site maintenance program called CUSFMAINT. CUSFMAINT is a typical simple file maintenance application that contains all screen handling, database access, and business logic in one tightly coupled unit. X-Analysis can identify the business logic in the program and display it. To recover the business rules for CUSFMAINT, perform the following steps:

1. CUSFMAINT is in the application area that we defined earlier. Expand the **MAIN_MENU** node in the X-Analysis client navigation panel and double-click **Programs**.
2. Right-click **CUSFMAINT** in the list of programs, and select **Derive Business Rules** from the context menu (Figure 5-22).

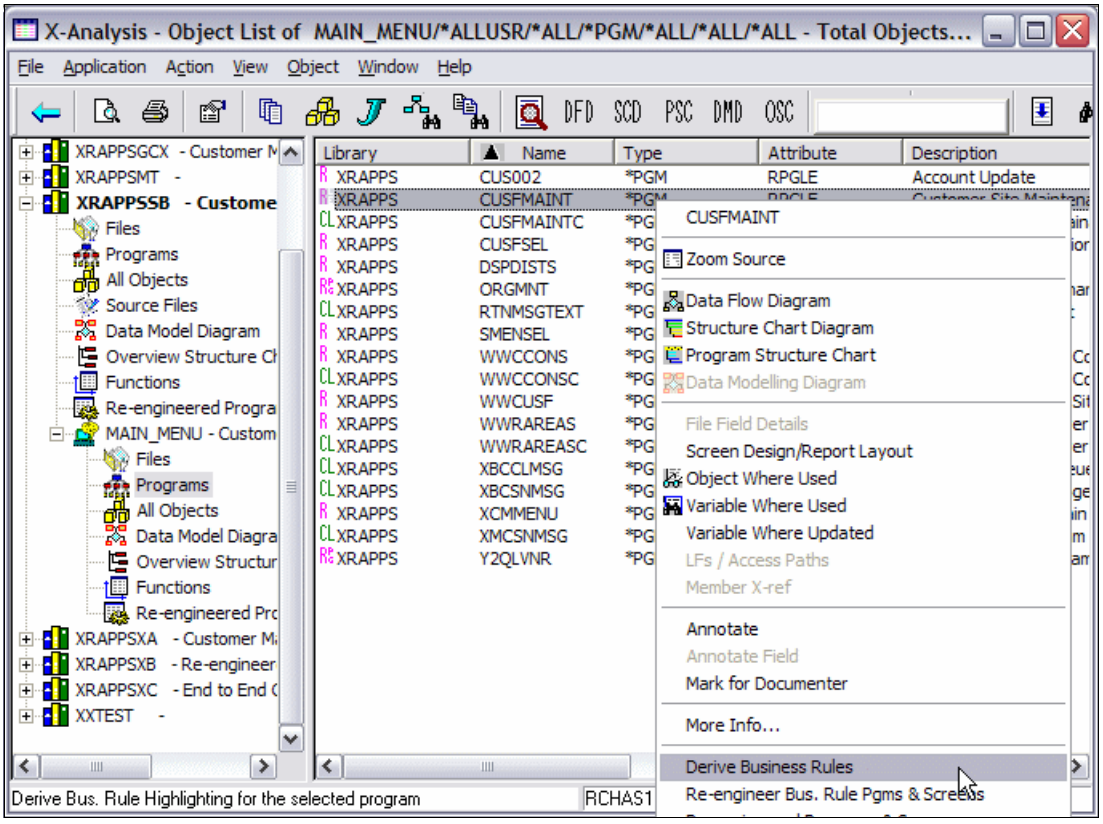

Figure 5-22 The Derive Business Rules menu option

3. The Derive Bus. Rule dialog is displayed to confirm your selection (Figure 5-23). Click **OK**.

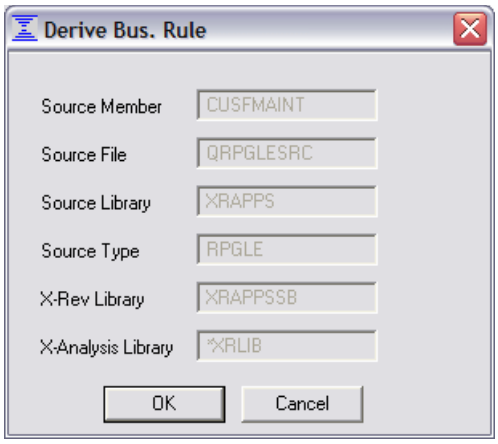

Figure 5-23 The Derive Bus. Rule confirmation dialog

4. X-Analysis submits a job on the server to process your selection. The job's progress is displayed (Figure 5-24). Click **Close** when it completes.

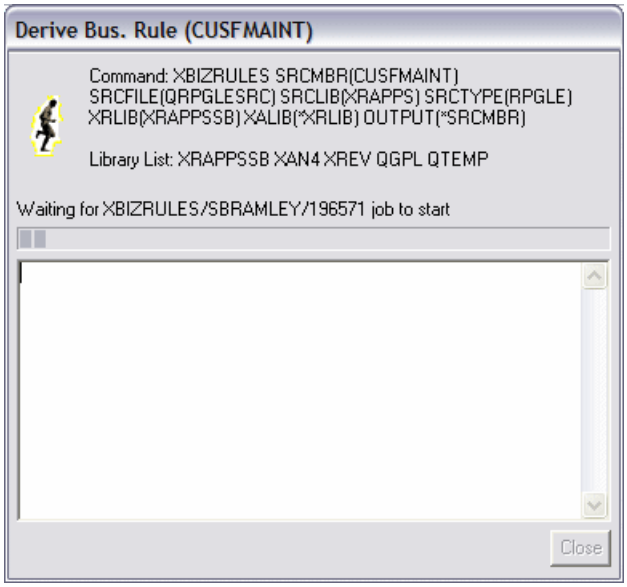

Figure 5-24 Progress dialog when deriving business rules

5. Double-click **CUSFMAINT** in the list of programs (Figure 5-22 on page 215) to view its source code.

6. X-Analysis shows the complete source of the program by default. To view the business rules that it derives (Figure 5-25), select **View** → **Business Rules Code**.

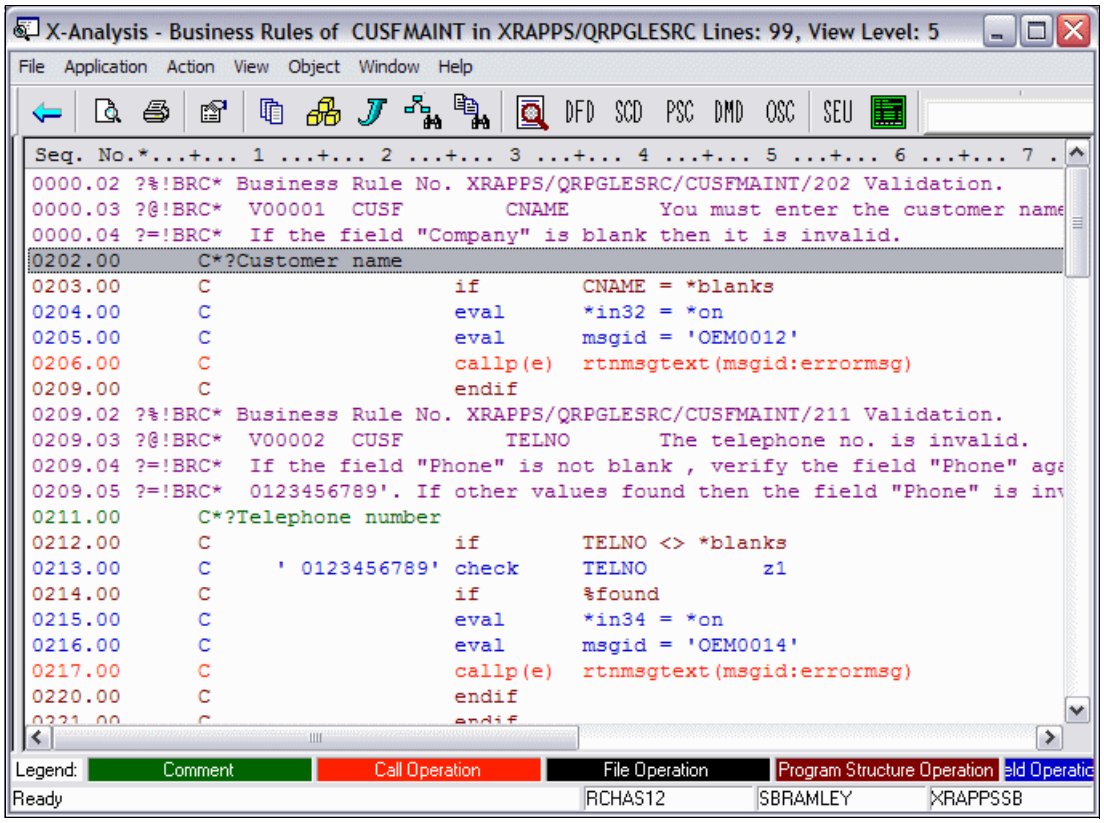
X-Analysis - Business Rules of CUSFMAINT in XRAPPS/QRPGLESRC Lines: 99, View Level: 5
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
Seq. No.*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 .
0000.02 ?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/202 Validation.
0000.03 ?@!BRC* V00001 CUSF CNAME You must enter the customer name
0000.04 ?=!BRC* If the field "Company" is blank then it is invalid.
0202.00 C*?Customer name
0203.00 C if CNAME = *blanks
0204.00 C eval *in32 = *on
0205.00 C eval msgid = 'OEM0012'
0206.00 C callp(e) rtnmsgtext(msgid:errormsg)
0209.00 C endif
0209.02 ?%!BRC* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/211 Validation.
0209.03 ?@!BRC* V00002 CUSF TELNO The telephone no. is invalid.
0209.04 ?=!BRC* If the field "Phone" is not blank , verify the field "Phone" aga
0209.05 ?=!BRC* 0123456789'. If other values found then the field "Phone" is inv
0211.00 C*?Telephone number
0212.00 C if TELNO <> *blanks
0213.00 C ' 0123456789' check TELNO z1
0214.00 C if %found
0215.00 C eval *in34 = *on
0216.00 C eval msgid = 'OEM0014'
0217.00 C callp(e) rtnmsgtext(msgid:errormsg)
0220.00 C endif
Legend: Comment Call Operation File Operation Program Structure Operation
Ready RCHAS12 SBRAMLEY XRAPPSSB

Figure 5-25 Business rules view for CUSFMAINT

7. X-Analysis can display these business rules as pseudo code (Figure 5-26). Select **View** → **Business Rules Pseudo Code**.

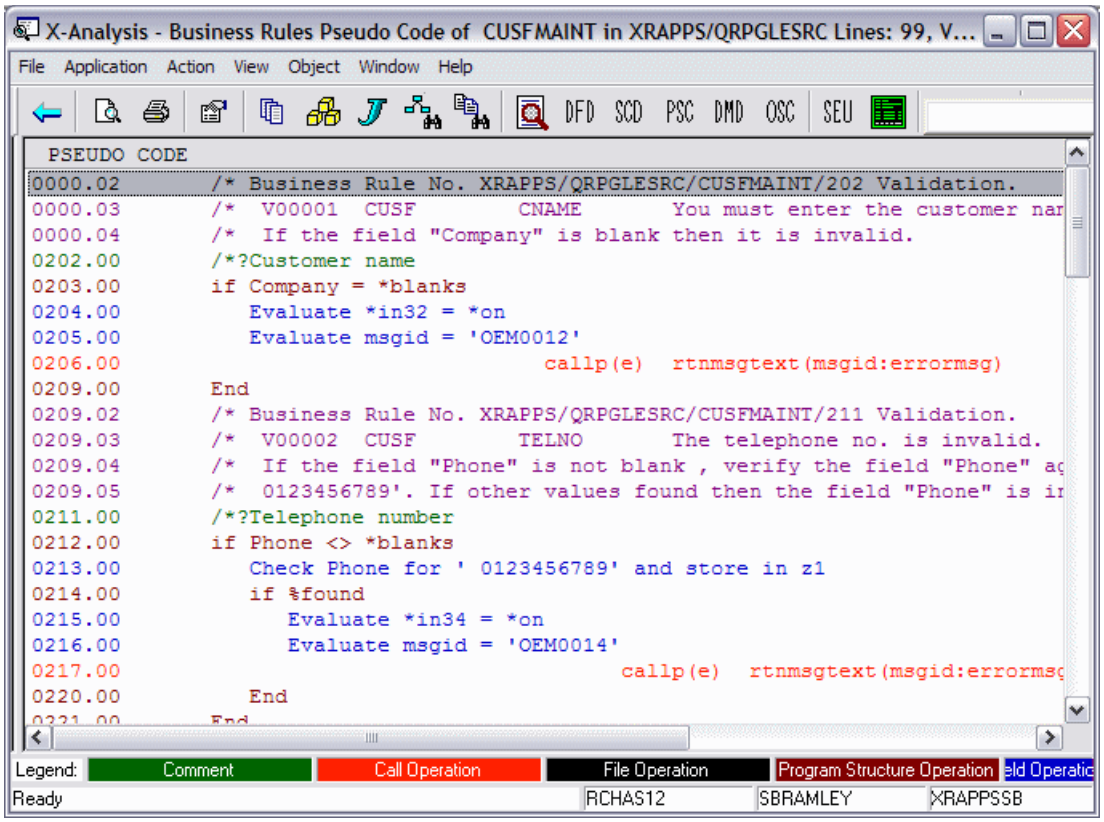
X-Analysis - Business Rules Pseudo Code of CUSFMAINT in XRAPPS/QRPGLESRC Lines: 99, V...
File Application Action View Object Window Help
DFD SCD PSC DMD OSC SEU
PSEUDO CODE
0000.02 /* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/202 Validation.
0000.03 /* V00001 CUSF CNAME You must enter the customer nar
0000.04 /* If the field "Company" is blank then it is invalid.
0202.00 /*?Customer name
0203.00 if Company = *blanks
0204.00 Evaluate *in32 = *on
0205.00 Evaluate msgid = 'OEM0012'
0206.00 callp(e) rtnmsgtext(msgid:errormsg)
0209.00 End
0209.02 /* Business Rule No. XRAPPS/QRPGLESRC/CUSFMAINT/211 Validation.
0209.03 /* V00002 CUSF TELNO The telephone no. is invalid.
0209.04 /* If the field "Phone" is not blank , verify the field "Phone" ag
0209.05 /* 0123456789'. If other values found then the field "Phone" is ir
0211.00 /*?Telephone number
0212.00 if Phone <> *blanks
0213.00 Check Phone for ' 0123456789' and store in z1
0214.00 if %found
0215.00 Evaluate *in34 = *on
0216.00 Evaluate msgid = 'OEM0014'
0217.00 callp(e) rtnmsgtext(msgid:errormsg
0220.00 End
Legend: Comment Call Operation File Operation Program Structure Operation
Ready RCHAS12 SBRAMLEY XRAPPSSB

Figure 5-26 Business Rules Pseudo Code view of CUSFMAINT

In addition to deriving the business rules behind the screen validation in this program, X-Analysis relates the business rule back to the application data model. In Figure 5-26, the rule for validating a customer's telephone number is applied to the TELNO field on the CUSF file. From a logical point of view you see the identified business entity customer, which has a property of `telephone number`. Both the business rule for validating the telephone number and where it is physically stored and maintained in the application are now known.

Tip: To derive the business rules for an entire application or application area, right-click the node in the X-Analysis client navigation pane and select **Derive Business Rules**.

6

Using the recovered model

This chapter describes how you can make further use of the application model that X-Analysis created. You will learn how to export the data model to other applications and how to make further use of the metadata X-Analysis has built.

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6.1 Exporting the data model

Modern software design tools frequently offer the facility to reverse-engineer a data model or entity relationship diagram (ERD) from an existing database. This is usually done over an Open Database Connectivity (ODBC) connection, relying on the metadata in a database to describe the relationships between tables. These tools are often unable to reverse-engineer an accurate data model from an existing DB2 database because it predates the database features that the tool relies on. You can use the X-Analysis data model to bridge this gap and import your data model into other tools.

6.1.1 Exporting XML Metadata Interchange

XML Metadata Interchange (XMI) is an open standard for the exchange of design metadata in an XML format. Tools can export and import XMI to enable designers to exchange their designs with other people using a different tool. X-Analysis can export the data model that it generates for an application or an application area as XMI. The XMI version can be imported into any third-party tool that supports XMI.

To export the XMI for the sample Customer Management System data model:

1. Open the Customer Management System in X-Analysis. Double-click **Data Model Diagram**.
2. Click **OK** in the Data Modelling Diagram dialog to include everything in the application.
3. Select **Action** → **Export as XMI**.
4. X-Analysis generates the XMI and tells you the generated filename (Figure 6-1). Click **OK**.

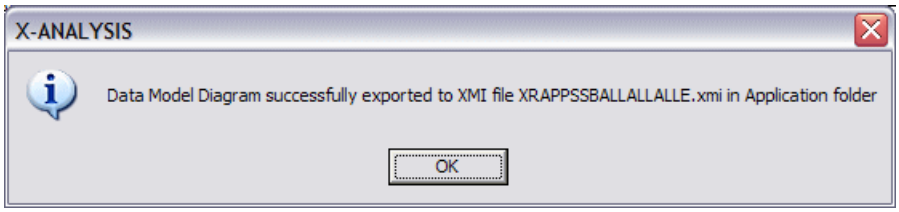

Figure 6-1 XMI export confirmation

5. Select **Application** → **Open Application Folder**

   Your XMI file is in this folder and ready to import into the tool of your choice.

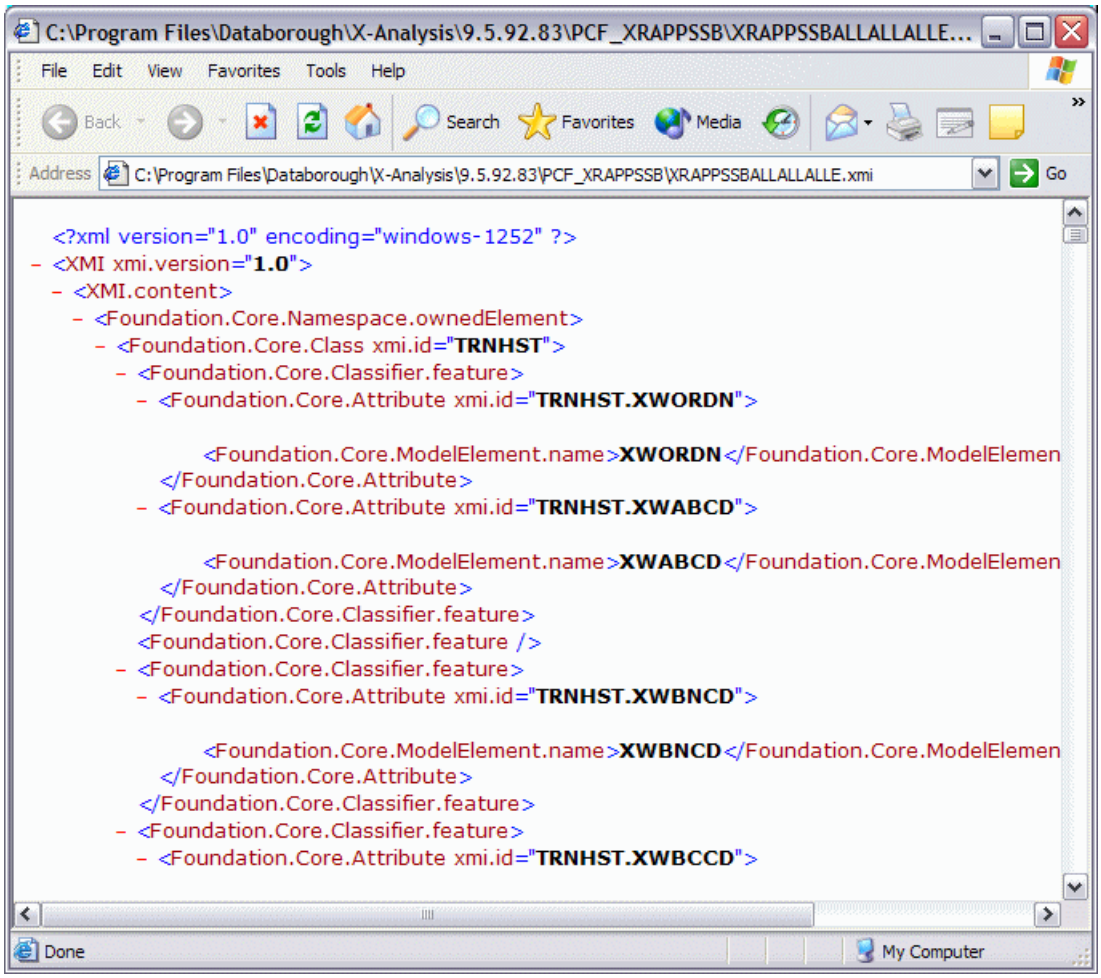

Figure 6-2 Example XMI generated for the CMS application

6.1.2 Exporting DDL

Data Definition Language (DDL) is a sequence of Structured Query Language (SQL) commands that defines the structure of a database. X-Analysis can export the structure of an application or application area as DDL. DDL can be used to re-create a database on any SQL database system. If your modelling tool does not support XMI, you can use DDL to re-create your database as SQL tables, complete with the metadata required for a tool to reverse-engineer the new database over ODBC. Some modelling tools also enable you to import SQL scripts or DDL files directly.

To export the DDL for the sample Customer Management System data model:

1. Open the Customer Management System (CMS) in the X-Analysis client. In this example the CMS model used is contained in the application area XRAPPSSB.
2. Double-click **Data Model Diagram**.
3. Click **OK** in the Data Modelling Diagram dialog to include everything in the application.

4. Select **Action** → **Export as DDL**. X-Analysis displays a progress dialog while it generates the DDL (Figure 6-3).

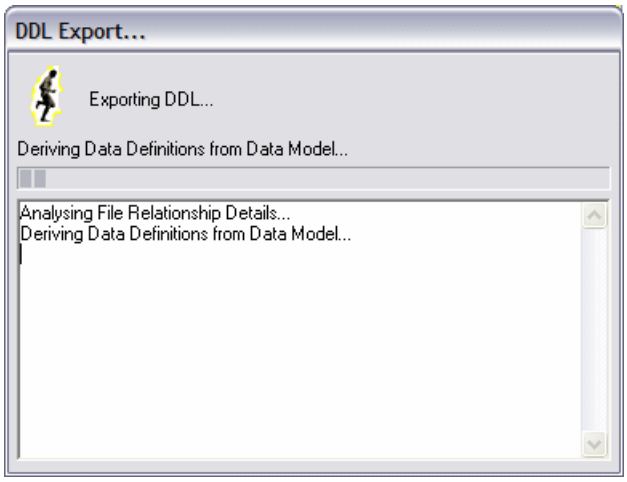
DDL Export...
Exporting DDL...
Deriving Data Definitions from Data Model...
Analysing File Relationship Details...
Deriving Data Definitions from Data Model...

Figure 6-3 DDL export progress dialog

When the export is complete, it tells you the generated filename (Figure 6-4). Click **OK**.

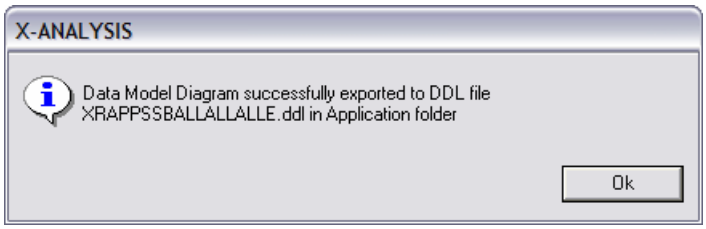

Figure 6-4 DDL export confirmation dialog

5. Select **Application** → **Open Application Folder**. Your DDL file is in this folder. DDL is plain text and human readable so you can view the file in any text editor, such as Notepad (Figure 6-5).

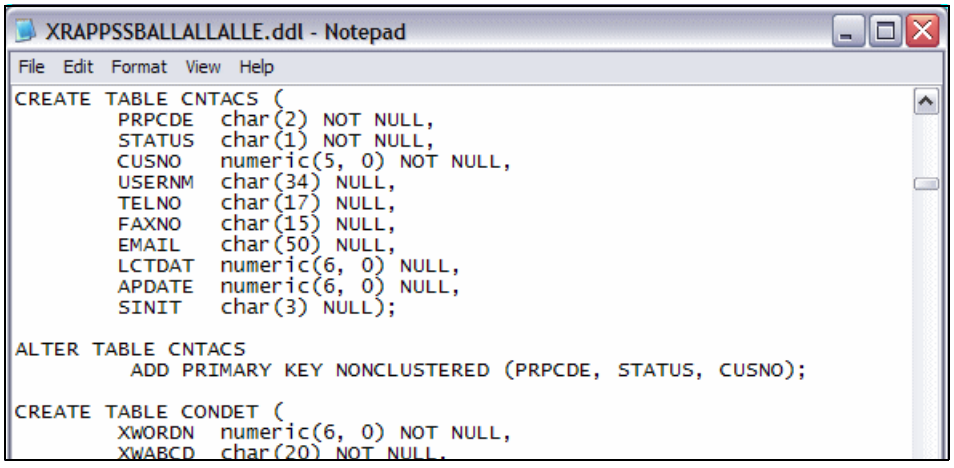

Figure 6-5 Example DDL generated for the CMS database

Note: This approach works on another iSeries but not on another DB2 because no table space is specified. The user will have to make modifications.

6.1.3 Exporting to Microsoft Visio

X-Analysis generates Microsoft Visio drawings for any X-Analysis data model diagram. You can share these drawings with other Visio users or you can incorporate them into your documentation if you have Microsoft Visio installed on your PC.

To export the data model diagram for the sample Customer Management System data model to Visio:

1. Open the Customer Management System in X-Analysis. Double-click **Data Model Diagram**.
2. Click **OK** in the Data Modelling Diagram dialog to include everything in the application.
3. Select **Action** → **Export to MS Visio**.

   X-Analysis generates a new Visio entity relationship diagram (Figure 6-6). Depending on your security settings, Visio may prompt you to enable macros during this process

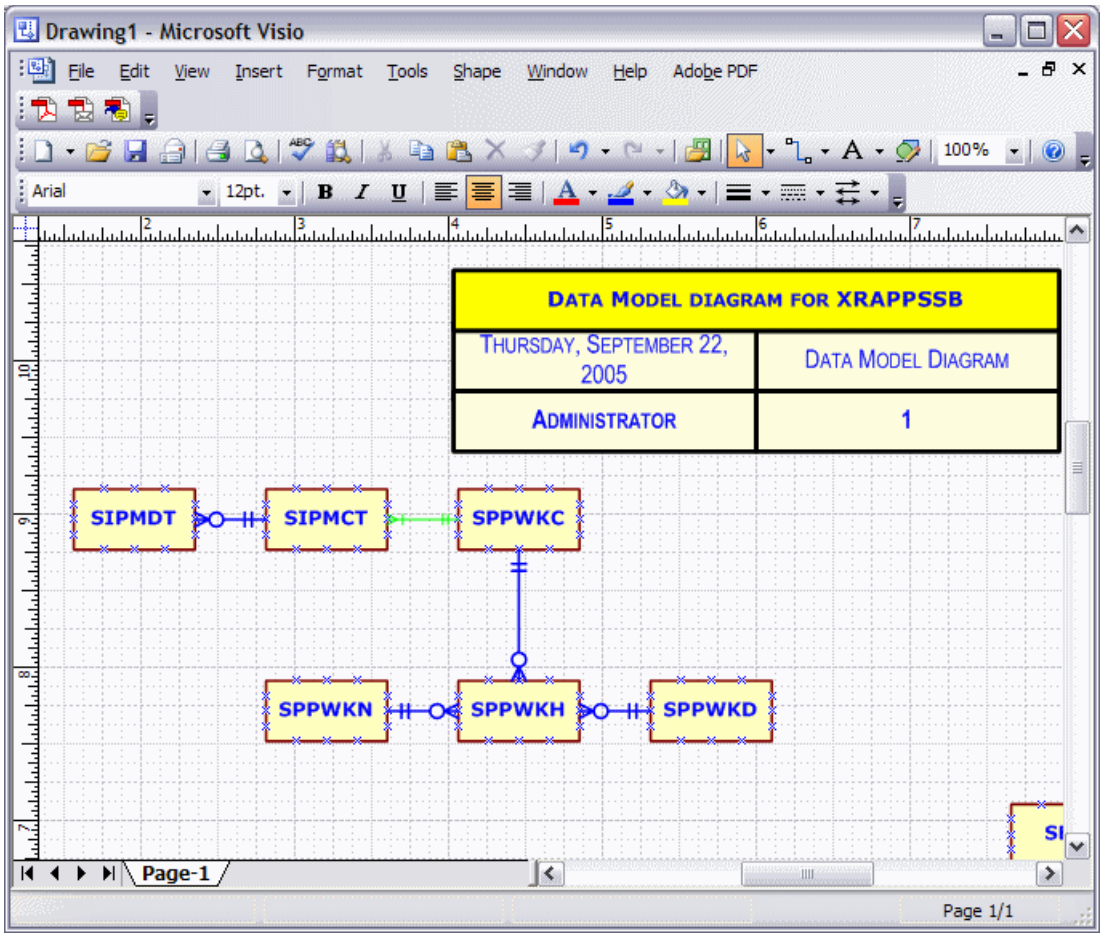

Figure 6-6 CMS data modelling diagram exported into Microsoft Visio

6.2 Using the X-Analysis database

The metadata database that underlies X-Analysis is a valuable resource, and it contains information that can be leveraged for your own purposes. In this section we examine the structure of the database and show some examples of how you might use the information that it contains.

6.2.1 The data model database

The X-Analysis data modelling process generates five core tables (Table 6-1).

Table 6-1 Tables generated by the X-Analysis data modelling process

Name	Description
XPIDS	Primary identifiers
XDD	Data dictionary
XRELS	Relationships
XSHKEYS	Relationship detail
XKEYMAP	Access paths

Figure 6-7 depicts the relationship between the tables.

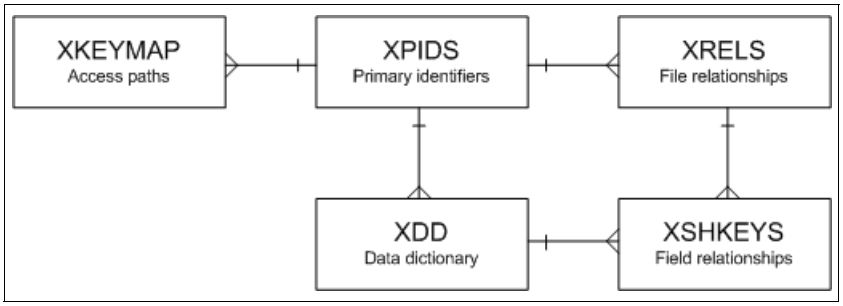

Figure 6-7 The X-Analysis data model database

Table XPIDS

Each physical file in the application has a record in the XPIDS table.

Table 6-2 XPIDS file layout

Field	Datatype	Length	Description
PIDPF	CHAR	10	The name of the physical file.
PIDLF	CHAR	10	The name of the access path containing the primary key.
TEXT	CHAR	50	The description of the access path file (DDS text or SQL label).
NORMLF	CHAR	10	This is a reserved field.
PIDNUM	CHAR	1	Yes or No flag indicating whether the file has an automatically incremented sequential key.
KEYnn	CHAR	10	The key fields to the file in order. The model supports up to 10 key fields in a file key. The field names are as they appear in the physical file.
ALWDSP	CHAR	1	Governs whether a display record function is allowed.
ALWUPD	CHAR	1	Governs whether an update record function is allowed.
ALWDEL	CHAR	1	Governs whether a delete record function is allowed.
PFLVID	CHAR	13	The record format level identifier of the version of the file that this record describes.

Field	Datatype	Length	Description
PFDTYP	CHAR	10	An array of 1A fields that contain the data types of each of the key fields held in KEY1-KEY10. The possible values for this field are: A - Alphanumeric P - Packed decimal S - Zoned decimal
PFTEXT	CHAR	50	Provides the description of the physical file (DDS text or SQL label).
XWAMTF	CHAR	10	Used by the X-Web module, indicating the field used to store prices in this record.
XWDESC	CHAR	10	Used by the X-Web module, indicating the field used to store descriptions in this record.
XWQTYF	CHAR	10	Used by the X-Web module, indicating the field used to store quantities in this record.
XWUTYF	CHAR	10	Used by the X-Web module, indicating the field used to store units in this record.
PDPFLB	CHAR	10	Identifies the application library that the physical file belongs to.

Table XDD

Table XDD is the data dictionary. There is a record in this file for every field in the application database.

Table 6-3 XDD file layout

Field	Datatype	Length	Description
VFLD	CHAR	10	Field name
VFILE	CHAR	10	Physical file name
FLDCLS	CHAR	10	Reserved
SEQGRD	PACKED	5,2	The sequence the field is displayed in when shown in an X-Analysis Grid Function.
SEQFSC	PACKED	5,2	The sequence the field is displayed in when shown in an X-Analysis Flat Screen Function.
FTYP	CHAR	1	Field type - certain fields on a file have a specific function that X-Analysis understands: K - This is the last field in the file key. H - This field is in the key but is not the last field. D - This is a text descriptor that summarizes the content of the record (for example, a name or description field).
ECDE	CHAR	1	The iSeries edit code used for this field.
FGNK	CHAR	1	Denotes type of foreign key field: N - Not a foreign key field F - Foreign key field R - (undocumented)
BNAW	CHAR	1	Yes or No flag indicates whether the field must have a value.

Field	Datatype	Length	Description
CDFD	CHAR	1	Yes or No flag to indicate whether there are records on the XCODES file for this field. XCODES contain a list of allowable values for the field.
YNFD	CHAR	1	Yes or No flag to indicate whether this is a Yes or No field. If Yes (Y), only the values “Y” or “N” may be entered into the field.
DATP	CHAR	1	If identified as a date or time field, this field indicates the type of date: Z - Timestamp T - Time D - Date 6 - Six-digit date 7 - Seven-digit date 8 - Eight-digit date
DATF	CHAR	10	If identified as a date or time field, this indicates the format of the date. This may be a standard format (for example *ISO) or a descriptive format (for example, CCYYMMDD).
VPGM	CHAR	10	The name of an external validation program that can be called to validate the field content.
VPRM	CHAR	1	Indicates whether only the field itself or the entire database record is passed to the validation program held in VPGM.
VCHK	CHAR	1	Indicates whether the validation program is called when the field is blank.
XVAL	CHAR	1	Reserved
WPTYP	CHAR	2	(undocumented)
GATTR	CHAR	1	The typical display characteristics of the field: H - Hidden (it is never displayed on screen) O - Output only B - Both input and output P - The field cannot be used by an application
WHCHD1	CHAR	20	Reserved
WHCHD2	CHAR	20	Reserved
WHCHD3	CHAR	20	Reserved
FLDHDG	CHAR	50	The column heading for the field
FDATTR	CHAR	1	Data type: A - Alphanumeric P - Packed decimal S - Zoned decimal
FLDLEN	CHAR	3	Field length in bytes
FLDDEC	CHAR	2	Decimal precision
FLDBFP	CHAR	5	The position of the field in the record buffer.
FLDDLN	CHAR	3	Used by X-Web to control what length of the field is displayed.
FMGRP	CHAR	1	Used to control grouping of fields in displays.

Table XRELS

The XRELS table details the relationships between tables in the data model.

Table 6-4 XRELS file layout

Field	Datatype	Length	Description
OWNPF	CHAR	10	The physical file that is the parent in the relationship.
OWNTXT	CHAR	50	The text associated with the parent file.
DEPPF	CHAR	10	The physical file that is the child in the relationship.
DEPSEQ	PACKED	5,2	Used to order the child relationships that the parent file has.
DEPTXT	CHAR	50	The text associated with the child file.
DEPLF	CHAR	10	The access path that is used to retrieve records from the child file. This will be the access path that is sequenced by the foreign key fields in the relationship.
RFONLY	CHAR	1	Describes the type of relationship: Y - There is no access path over the child file sequenced by the foreign key (Refers To). O - The access path held in DEPLF is the primary access path for the child (as specified in the field PIDLF on the file XPIDS) (Owns). Blank - The access path held in DEPLF is not the primary access path for the child (Accesses).
ORIGIN	CHAR	1	Reserved
OWNLF	CHAR	10	Reserved
RELID	PACKED	7,0	This is a unique identifier for this relationship.
R1T1	CHAR	1	Flag indicating a one-to-one rather than a one-to-many relationship.
RELPTY	CHAR	1	Used to sequence referential integrity tests.

Table XSHKEYS

The XSHKEYS table is the child of the file XRELS and describes the fields involved in the relationships that it holds.

Table 6-5 XSHKEYS file layout

Field	Datatype	Length	Description
FILE	CHAR	10	The child file
MFILE	CHAR	10	The parent file
KSEQ	PACKED	5,2	The sequence of the fields in the key
FLD	CHAR	10	Field on the child file
MFLD	CHAR	10	Field on the parent file
CONST	CHAR	20	A constant value used to join the files
RELID	PACKED	7,0	The unique identifier for the relationship as held on XRELS

XKEYMAP

The XKEYMAP table details all of the access paths over each physical file in the data model.

Table 6-6 XKEYMAP file layout

Field	Datatype	Length	Description
KMFILE	CHAR	10	The physical file that the access path is over.
KMLF	CHAR	10	The file containing the access path. (This may be the physical itself if it is keyed.)
KMKFLD	CHAR	200	An array of 10A elements holding the field names of the key fields. The field names are sequenced as they appear in the key.
KMRFLD	CHAR	200	Reserved
KMFAT1	CHAR	200	Reserved
KMFAT2	CHAR	200	Reserved
KMPFUN	CHAR	1	A flag indicating a physical file with a unique key.
KMSUPR	CHAR	10	Reserved
KM#OWN	ZONED	2,0	Reserved
KMLFTX	CHAR	50	Text associated with the logical file.
KMLFSQ	PACKED	5,0	Dictates the sequence the logical files over this physical file are displayed in.
KMLFKS	CHAR	1	Reserved
KMDKIX	CHAR	20	An array of 1A elements holding the data types of the fields in the key: A - Alphanumeric P - Packed decimal S - Zoned decimal
KMSELO	CHAR	1	Flag indicating whether the file has select/omit criteria specified.
KMFSEL	CHAR	1	Flag indicating whether the logical file renames fields from the physical file.
KMLFLB	CHAR	10	The library that the logical file resides in.

6.2.2 Using X-Browse to explore the data model database

The easiest way to view the data in the data model is to use the data dictionary facility provided within X-Analysis:

1. Open the Customer Management System in X-Analysis.
2. Click the data dictionary icon in the tool bar. An X-Browse window opens showing the data in the file XPIDS.

   For more information about using X-Browse, review 5.6, “Exploring the data in the database” on page 208.

6.3 Using the business rules database

The X-Analysis business rules extraction process builds metadata about your RPG applications in order to identify the business rules code. You can write your own programs and queries to use this metadata. For example, you may have code that has been copied between programs over a period of years. To improve the maintainability of this code, externalize the code from these programs. The problem that this poses is locating where the copied code has been used. Workfield names are likely to differ between programs. The code may have mutated slightly to fit developers' individual coding styles. It may have been adjusted to fit with the style of new releases of the RPG language. Simple string searches are therefore unlikely to be a good way of identifying where the code has been replicated. You could manually search through source code but this would be a painful and time-consuming process. The business rules database can be used in conjunction with X-Analysis to mitigate the effort.

The business rules extraction process builds information in several layers. Each layer uses information gathered in the previous step. At each level the data becomes more directly related to business rules. The levels are:

- Level 1: Contains raw information about source code in individual programs.
- Level 2: Identifies the logical purpose of some of the programs and fields in the system.
- Level 3: Identifies the purpose of blocks of code within a program.

6.3.1 Level 1

Tables at level 1 contain raw information about source code in individual programs:

XERRIND	Holds indicators used as error message indicators in a program.
XEXFLDCMPS	Contains valid comparisons for fields specified in programs.
XEXFLDRNGS	Contains valid ranges of values for fields specified in programs.
XEXFLDTRKR	Tracks the movement of data between fields in programs.
XEXFLDVALS	Details the permitted values for a field in a program.
XEXPGMBLKS	Describes code block structures in a program and how they are nested.
XEXPGMFLDS	Stores the fields that have been defined in the program.
XEXPGMLSTS	Holds details of the list structures.
XEXPGMMGSS	Details the program statements where messages are referenced.
XEXPGMSTTS	Holds generic statement types as they occur in a program.
XEXPGMCTAS	Holds details of the compile time array defined in a program.

Table XERRIND

Table XERRIND holds indicators used as error message indicators within programs. Each indicator definition has two records on this file. The first record has the indicator listed by number in the indicator field. The second record sets the position for this indicator in the indicator array field to 1.

Table 6-7 XERRIND file layout

Field	Datatype	Length	Description
XEPGM	CHAR	10	Program
XEIND	CHAR	2	Indicator
XEFLD	CHAR	30	Field
XEFILE	CHAR	10	The device file where the indicator is used
XEFMT	CHAR	10	The record format that the indicator is defined on

Field	Datatype	Length	Description
XEEMID	CHAR	7	Message ID
XEEMFL	CHAR	10	Message file
XEEMLB	CHAR	10	Message File Library
XERMTX	CHAR	50	The error message text
XEINARR	CHAR	99	Array of 1A elements representing the Indicator array

Table XEXFLDCMPS

This table contains valid comparisons for fields specified within programs. For example, if a display file uses the COMP keyword, it specifies a test that the user input must pass to be valid. If the field is subsequently used to update the database, the test appears as a record on this file.

Table 6-8 XEXFLDCMPS file layout

Field	Datatype	Length	Description
FCMMBR	CHAR	10	Source member
FCMFIL	CHAR	10	Source file
FCMLIB	CHAR	10	Source library
FCMPF	CHAR	10	Physical file
FCMFLD	CHAR	30	Field text
FCMCND	CHAR	2	Comparison condition
FCMVAL	CHAR	30	Comparison value

Table XEXFLDRNGS

This table contains valid ranges of values for fields specified within programs.

Table 6-9 XEXFLDRNGS file layout

Field	Datatype	Length	Description
FRGMBR	CHAR	10	Source member
FRGFIL	CHAR	10	Source file
FRGLIB	CHAR	10	Source library
FRGPF	CHAR	10	Physical file
FRGFLD	CHAR	30	Field
FRGLOV	CHAR	30	Lowest value
FRGHIV	CHAR	30	Highest value

Table XEXFLDTRKR

This table tracks the movement of data between fields in programs.

Table 6-10 XEXFLDTRKR file layout

Field	Datatype	Length	Description
TRKMBR	CHAR	10	Source member
TRKFIL	CHAR	10	Source file
TRKLIB	CHAR	10	Source library
TRKRRN	ZONED	5,0	Relative record number (RRN) of the source instruction
TRKFRF	CHAR	30	From field
TRKTOF	CHAR	30	To field
TRKDIR	CHAR	1	Direction - which field is the data moving from: F - The data is being moved from the from field (TRKFRF) into the to field (TRKTOF). T - The data is being moved from the to field (TRKTOF) into the from field (TRKFRF).

Table XEXFLDVALS

This table details the permitted values for a field in a program. There is one record on this file for each permitted value. For example, if a display file uses the VALUES keyword it restricts the values that the user can enter for a field. If the field is subsequently used to populate a field on the database, then the database field has a record on this file for each value specified on the VALUES keyword.

Table 6-11 XEXFLDVALS file layout

Field	Datatype	Length	Description
FVLMBR	CHAR	10	Source member
FVLFIL	CHAR	10	Source file
FVLLIB	CHAR	10	Source library
FVLPF	CHAR	10	Physical file
FVLFLD	CHAR	30	Field
FVLVAL	CHAR	30	Permitted field value

Table XEXPGMBLKS

This table describes the code block structures within a program and how they are nested.

Table 6-12 XEXPGMBLKS file layout

Field	Datatype	Length	Description
BLKMBR	CHAR	10	Source member
BLKFIL	CHAR	10	Source file
BLKRRN	ZONED	5,0	The relative record number (RRN) of the source statement where the block operation occurs

Field	Datatype	Length	Description
BLKBXE	CHAR	1	Type of block operation: B - Begin (example is IF) X - Extend (example is ELSE) E - End (example is ENDIF)
BLKLVL	ZONED	3,0	Nesting level
BLKTYP	CHAR	10	RPG operation code

Table XEXPGMFLDS

This table stores the fields defined in a program.

Table 6-13 XEXPGMFLDS file layout

Field	Datatype	Length	Description
FLDMBR	CHAR	10	Source member
FLDFIL	CHAR	10	Source file
FLDLIB	CHAR	10	Source library
FLDFLD	CHAR	30	Field
FLDTYP	CHAR	1	Field type
FLDLEN	ZONED	3,0	Field length
FLDDEC	CHAR	2	Field decimal places
FLDDYN	CHAR	1	Date field (Y/N)
FLDORI	CHAR	1	Field origin: W- Workfield D - Database
FLDDFL	CHAR	10	If the field is linked to a database field, specifies the field name.
FLDDRF	CHAR	10	Name of renamed record format
FLDDBF	CHAR	30	Name of the field as defined on the database
FLDLKF	CHAR	30	Like field
FLDLKS	CHAR	1	Like field adjusted sign
FLDLKV	ZONED	2,0	Like field adjusted value
FLDTRK	CHAR	30	If the field is linked to a tracked database field, what the field name is.
FLDDVF	CHAR	10	The device file that the field is defined on.
FLDDFF	CHAR	10	The record format in the device file that the field is defined on.
FLDSTR	CHAR	30	The name of the data structure that contains the field.
FLDDTF	CHAR	1	Date format

Table XEXPGMLSTS

XEXPGMLSTS holds details of the list structures (key lists and parameter lists) defined in a program. There will be one record for each field in the list.

Table 6-14 XEXPGMLSTS file layout

Field	Datatype	Length	Description
LSTMBR	CHAR	10	Source member
LSTFIL	CHAR	10	Source file
LSTLIB	CHAR	10	Source library
LSTRRN	ZONED	5,0	RRN of the source statement where the list is defined
LSTTYP	CHAR	1	List type: K - Key list P - Parameter list
LSTLST	CHAR	20	List name. If this is defined in line (for example a prototyped call or by using PARM statements after the CALL operation), this is generated.
LSTSEQ	ZONED	3,0	The sequence of the field within the list
LSTFLD	CHAR	30	The name of the field in the list

Table XEXPGMMGSS

XEXPGMMGSS details the program statements where messages are referenced.

Table 6-15 XEXPGMMGSS file layout

Field	Datatype	Length	Description
MSGMBR	CHAR	10	Source member
MSGFIL	CHAR	10	Source file
MSGLIB	CHAR	10	Source library
MSGRRN	ZONED	5,0	RRN of the source statement where the message is referenced
MSGMID	CHAR	7	Message ID
MSGMFL	CHAR	10	Message file
MSGMLB	CHAR	10	Message file library
MSGMTX	CHAR	50	Message text
MSGEIN	CHAR	2	Any program error indicator associated with the message
MSGEFD	CHAR	30	The underlying database field that the error refers to
MSGEFL	CHAR	10	The file that the underlying database field is on

Table XEXPGMSTTS

This table holds the generic types of statements as they occur in a program. For example, any operations that compare variables (such as IF or WHEN) are logically grouped as the same generic type of operation.

Table 6-16 XEXPGMSTTS file layout

Field	Datatype	Length	Description
STTMBR	CHAR	10	Source member
STTFIL	CHAR	10	Source file
STTLIB	CHAR	10	Source library
STTRRN	ZONED	5,0	Source RRN
STTTYP	CHAR	10	Statement type
STTTQL	CHAR	10	Type qualifier

Table XEXPGMCTAS

This table holds details of the compile time arrays that are defined in a program.

Table 6-17 XEXPGMCTAS file layout

Field	Datatype	Length	Description
CTAMBR	CHAR	10	Source member
CTAFIL	CHAR	10	Source file
CTALIB	CHAR	10	Source library
CTACTA	CHAR	30	Compile time array name
CTARRN	ZONED	5,0	RRN of the source statement where the array is located. This is the content of the array rather than the definition of the variable.

6.3.2 Level 2

The level 2 data derivation identifies the logical purpose of some of the programs and fields in a system. Level 2 contains these files:

XEXPMTFLDS Details which fields programs use as prompt fields
XEXRTNCDES Details which fields programs uses a return codes.
XEXSELPGMS Details programs other programs use to perform record selection from a list.
XEXUPDFUNS Contains the physical files causing X-Analysis functions to be created.
XEXVALFLGS Contains validation flags.

Table XEXPMTFLDS

This table details the fields programs use as prompt fields. Prompt fields are fields that are used to request a prompt or selection program and can be excluded from business rules.

Table 6-18 XEXPMTFLDS file layout

Field	Datatype	Length	Description
PMTMBR	CHAR	10	Source member
PMTFIL	CHAR	10	Source file

Field	Datatype	Length	Description
PMTLIB	CHAR	10	Source library
PMTPMT	CHAR	30	Prompt field

Table XEXRTNCDES

XEXRTNCDES details which fields programs use as return codes. This enables the identification of validation code where a program is passed values and returns a result.

Table 6-19 XEXRTNCDES file layout

Field	Datatype	Length	Description
RTCMBR	CHAR	10	Source member
RTCFIL	CHAR	10	Source file
RTCLIB	CHAR	10	Source library
RTCCDE	CHAR	30	Return code field

Table XEXSELPGMS

This table details which programs other programs use to perform record selection from a list. These calls can be excluded from business rules.

Table 6-20 XEXSELPGMS file layout

Field	Datatype	Length	Description
SELMBR	CHAR	10	Source member
SELFIL	CHAR	10	Source file
SELLIB	CHAR	10	Source library
SELPGM	CHAR	10	Selection program

Table XEXUPDFUNS

This table contains the physical files for which X-Analysis functions are created currently performed in this program.

Table 6-21 XEXUPDFUNS file layout

Field	Datatype	Length	Description
UDFMBR	CHAR	10	Source member
UDFFIL	CHAR	10	Source file
UDFLIB	CHAR	10	Source library
UDFFUN	CHAR	10	Function file
UDFTYP	CHAR	1	Function type
UDFMAP	CHAR	20	Map name

Table XEXVALFLGS

Table XEXVALFLGS identifies validation flags, which are fields set to indicate error conditions within a program. They are similar to return codes but are not used as program parameters.

Table 6-22 XEXVALFLGS file layout

Field	Datatype	Length	Description
VLFMBR	CHAR	10	Source member
VLFFIL	CHAR	10	Source file
VLFLIB	CHAR	10	Source library
VLFFLG	CHAR	30	Validation flag

6.3.3 Level 3

Level 3 derivation identifies the purpose of blocks of code in a program. It contains these files:

XEXTRGLINS Identifies the trigger lines within a program.
XEXOTHFILS Details all non-owner file access performed in a program.

Table XEXTRGLINS

Table XEXTRGLINS contains the trigger lines. A trigger line is a line of code where a specific operation occurs within a program. The possible operations are:

- A comparison with a database field or a field linked to an underlying database field
- A comparison with a program return code
- A comparison with a program validation flag
- Comparing or setting the value of an error indicator after a subroutine is executed
- Comparing or setting the value of program parameters
- Database input or output for validation purposes
- Update of a file that is not the primary file in the program (*secondary update*)
- Reading a file that the program's primary file does not have at least a refers to relationship with in the X-Analysis data model (*non-owner read*)
- A call to a program that does *not* meet any of the following criteria:
  - Interactive programs
  - Print programs
  - Selection programs (as held on the file XEXSELPGMS)
  - Excluded programs (as held on the file XEXCPGM)
- Executing a validation subroutine
- A statement that references a message (as held on XEXPGMMGSS)
- A Synon User Exit Point
- Populating a screen workfield

Table 6-23 XEXTRGLINS file layout

Field	Datatype	Length	Description
TRGMBR	CHAR	10	Source member
TRGFIL	CHAR	10	Source file
TRGLIB	CHAR	10	Source library
TRGRRN	ZONED	5,0	Source RRN
TRGTYP	CHAR	1	Trigger type: V - Validation U - Secondary update R - Non-owner read C - Program call E - Execute validation subroutine P - Population of program parameters X - Synon user exit W - Populating a screen workfield
TRGVTP	CHAR	1	If field TRGTYP = V, this contains validation type: M - Message statement F - File validation statement C - Comparison statement If field TRGTYP = C, this contains call type: M - Message program D - Date program V - Validation program P - Print program *BLANK - Other program
TRGCTP	CHAR	1	Comparison type: F - Field comparison R - Return code comparison V - Validation flag comparison I - Resulting indicator comparison

Table XEXOTHFILS

This table holds details of all non-owner file access performed in a program.

Table 6-24 XEXOTHFILS file layout

Field	Datatype	Length	Description
OTFMBR	CHAR	10	Source member
OTFFIL	CHAR	10	Source file
OTFLIB	CHAR	10	Source library
OTFPF	CHAR	10	Physical file name
OTFTYP	CHAR	1	Type: R - Read U - Update

6.3.4 Level 4

Tables at level 4 hold the extracted business rules. The tables are:

XEXEXTLGC Contains trigger lines with a valid piece of business logic.
XEXBIZRLES Contains the definition of the business rules that were extracted.

Table XEXEXTLGC

This table contains information when a trigger line (XEXTRGLINS) contains a valid piece of business logic. In this case, the code block at the trigger line is written to this file.

Table 6-25 XEXTLGC file layout

Field	Datatype	Length	Description
EXTMBR	CHAR	10	Source member
EXTFIL	CHAR	10	Source file
EXTLIB	CHAR	10	Source library
EXTRRN	ZONED	5,0	The RRN of the source record
EXTTYP	CHAR	1	Extract type: As TRGTYP above and additionally: S - Validation subroutine T - Validation subroutine Z - Synon user exit or XBIZRULES derived logic D - Shadow program definition specification F - Shadow program file specification
EXTSTP	CHAR	1	Extract subtype: As TTGVTYP above and additionally: L - List type definition R - Rename type definition S - Secondary workfield move
EXTCDE	CHAR	100	Source code
EXTPF	CHAR	10	The underlying physical file that the code relates to
EXTFNC	CHAR	2	Function type

Table XEXBIZRLES

This table contains the definitions of the business rules that have been extracted.

Table 6-26 XEXBIZRLES file layoutr

Field	Datatype	Length	Description
BIZMBR	CHAR	10	Source member
BIZFIL	CHAR	10	Source file
BIZLIB	CHAR	10	Source library
BIZRRN	ZONED	5,0	RRN of the source line where the business rule occurs

Field	Datatype	Length	Description
BIZTYP	CHAR	1	Business rule type: C - Program call L - Field logic R - Non-owner file read V - Validation U - Secondary file update
BIZNUM	ZONED	5,0	Business rule number
BIZFLD	CHAR	30	The underlying tracked database field that this rule relates to.
BIZOBJ	CHAR	10	The file that the tracked field is on, or the program called if this rule is a program call.
BIZRUL	CHAR	100	Text description of the business rule
BIZSHMBR	CHAR	10	Shadow source member
BIZSHFIL	CHAR	10	Shadow source file
BIZSHLIB	CHAR	10	Shadow source library
BIZSHRRN	ZONED	5,0	Shadow source RRN
BIZACTIVE	CHAR	1	Is the business rule active? Yes or No
BIZCAT01	CHAR	10	Rule Category Number 01
BIZCAT02	CHAR	10	Rule Category Number 02
BIZCAT03	CHAR	10	Rule Category Number 03
BIZCAT04	CHAR	10	Rule Category Number 04
BIZCAT05	CHAR	10	Rule Category Number 05
BIZCAT06	CHAR	10	Rule Category Number 06
BIZCAT07	CHAR	10	Rule Category Number 07
BIZCAT08	CHAR	10	Rule Category Number 08
BIZCAT09	CHAR	10	Rule Category Number 09
BIZCAT10	CHAR	10	Rule Category Number 10

Here is a simple example of how you can apply this information to identify business rules. This is useful when modelling the functionality in the existing system as part of a modernization exercise.

The table XEXBIZRLES contains the business rules that exist in our system. The business rules are related back to underlying fields in our database. We can query XEXBIZRLES to display all of the business rules that are applied to a particular table. To do this for the Sites table CUSF, use the SQL statement shown in Example 6-1.

Example 6-1 Querying business rules applied to the sites table

```
SELECT
  BIZMBR, BIZFIL, BIZLIB, BIZRRN, BIZTYP, BIZNUM, BIZFLD, BIZOBJ, BIZRUL FROM
  XRAPPSSB/XEXBIZRLES WHERE BIZOBJ = ‘CUSF’ ORDER BY BIZMBR, BIZNMUM
```

This query produces the results shown in Figure 6-8. These results show that there are various business rules that are applied to fields on the file CUSF. You see that in the sample application these business rules have been duplicated. Both CUSFMAINT and WWCUSF would have to be amended if any of the business rules relating to the customer have to change. The BIZRRN field holds the relative record number of the source line where the business rule is coded into the source member. These results help you model the business logic in the existing application more easily than reading through the source alone.

BIZMBR	BIZFIL	BIZLIB	BIZRRN	BIZTYP	BIZNUM	BIZFLD	BIZOBJ	BIZRUL
CUSFMAINT	QRPGLESRC	XRAPPS	202	V	1	CNAME	CUSF	You must enter the customer name.
CUSFMAINT	QRPGLESRC	XRAPPS	211	V	2	TELNO	CUSF	The telephone no. is invalid.
CUSFMAINT	QRPGLESRC	XRAPPS	223	V	3	FAXNO	CUSF	The fax. no. is invalid.
CUSFMAINT	QRPGLESRC	XRAPPS	235	V	4	DSDCDE	CUSF	The distributor is invalid.
CUSFMAINT	QRPGLESRC	XRAPPS	247	V	5	STATUS	CUSF	The status is invalid.
CUSFMAINT	QRPGLESRC	XRAPPS	260	V	6	USERNM	CUSF	You must enter a contact name.
CUSFMAINT	QRPGLESRC	XRAPPS	269	V	7	SALUT	CUSF	The title is invalid.
WWCUSF	QRPGLESRC	XRAPPS	316	V	1	CUSNO	CUSF	Invalid customer number.
WWCUSF	QRPGLESRC	XRAPPS	323	V	2	CNAME	CUSF	You must enter the customer name.
WWCUSF	QRPGLESRC	XRAPPS	330	V	3	TELNO	CUSF	The telephone no. is invalid.
WWCUSF	QRPGLESRC	XRAPPS	339	V	4	FAXNO	CUSF	The fax. no. is invalid.
WWCUSF	QRPGLESRC	XRAPPS	348	V	5	DSDCDE	CUSF	The distributor is invalid.
WWCUSF	QRPGLESRC	XRAPPS	358	V	6	STATUS	CUSF	The status is invalid.
WWCUSF	QRPGLESRC	XRAPPS	367	V	7	USERNM	CUSF	You must enter a contact name.

Figure 6-8 Query results from Example 6-1 on page 239

A

Getting started with X-Analysis

This appendix describes how to install the X-Analysis software and associated products. We show how to:

- Prepare for the installation of X-Analysis
- Install X-Analysis on the iSeries and on the client
- Configure X-Analysis on the client
- Create a cross-reference repository and a data model for our sample application
- Install the X-Web Server

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Setting up X-Analysis

Prior to using X-Analysis, various activities must be performed to incorporate the product into your development environment. These activities are:

- Ensure that your development environment is ready to accommodate X-Analysis.
- Install X-Analysis on your iSeries and your development personal computer (PC).
- Configure X-Analysis on your PC.

To prepare for the modernization scenarios covered in this paper, we show you how to:

- Create a cross-reference repository for the Customer Management System (CMS), which is the sample application.
- Generate a data model for CMS.
- Give designer authority to the cross-reference repository.
- Access X-Analysis on the PC.
- Install X-Web Server.

Preparing for the X-Analysis installation

To ensure a successful installation of X-Analysis software, you must perform the following activities prior to installing the product:

1. Obtain an authorization code from Databorough. The authorization code is obtained by completing the License Code Request form (located in Appendix C of the *X-Analysis for Windows User Manual* that comes with the product). E-mail the completed form to sales@databorough.com.
2. Verify that your PC meets the following criteria:
   - Is an IBM-compatible PC with Microsoft Windows 98 (or later) operating system
   - Has a Internet Explorer 4.0 or later
   - Has Microsoft Office 97 (or later) for viewing the X-Analysis system documentation
3. Ensure that you are authorized to create and restore libraries and have the authority to perform various commands such as DSPDBR.
4. X-Analysis client software uses the JT400 driver to access data on the iSeries. Ensure that the following iSeries ports are accessible:
   - 449 for Toolbox for Java
   - 8470 for Toolbox for Java
   - 8471 for JDBC™ Database requests
   - 8475 for command calls
   - 8476 for signon (Toolbox for Java)

Installing X-Analysis

In order to set up X-Analysis in your development environment, the following main activities must be performed:

- Install X-Analysis software on the iSeries.
- Install X-Analysis software on the PC.
- Configure the X-Analysis software on the PC.

Installing X-Analysis on the iSeries

We are installing X-Analysis and all the extensions. To install X-Analysis on the iSeries, log on to the iSeries and perform the following steps:

1. Set the logging level to track any problems. Enter the following command:

   ```
   CHGJOB LOG(4 00 *SECLVL) LOGCLPGM(*YES)
   ```

2. Place the CD into the iSeries CD drive and on the command line enter:

   ```
   LODRUN DEV(*OPT)
   ```

3. Check the job log to verify that the job completed successfully. Add the XAN4 (X-Analysis) software library to the library list. On the command line enter:

   ```
   ADDLIBLE XAN4
   ```

4. On the command line enter this command (an X-Analysis command to start the authorization process):

   ```
   X@PSW
   ```

5. On the Password Maintenance screen (Figure A-1), enter the authorization code and iSeries serial number. Press Enter.

```
X-analysis            Password Maintenance                Databorough Ltd.

Type value, press enter.

XAN/4 password. . . . .  TWXXETZCILTTTX5XD8RL

Serial number . . . . .   65DOACD


    F1=Help             F3=Exit             F4=Prompt
```

Figure A-1 Enter authorization code

Installing X-Analysis client

The installation of the X-Analysis client consists of the following activities:

- Install any missing prerequisites.
- Install the X-Analysis software.

Install missing prerequisites

To install any missing prerequisites, perform the following step:

1. Place the CD into the local CD drive. The Databorough Product Suite window appears. Click the **Install X-Analysis** icon.

2. On the Install X-Analysis window (Figure A-2), click the **Install X-Analysis Pre-Requisites** icon, if the prerequisites are *not* already installed. The prerequisites are the Java Runtime Environment (JRE) 1.4.2 (or later) and associated Java Archive (JAR) files.

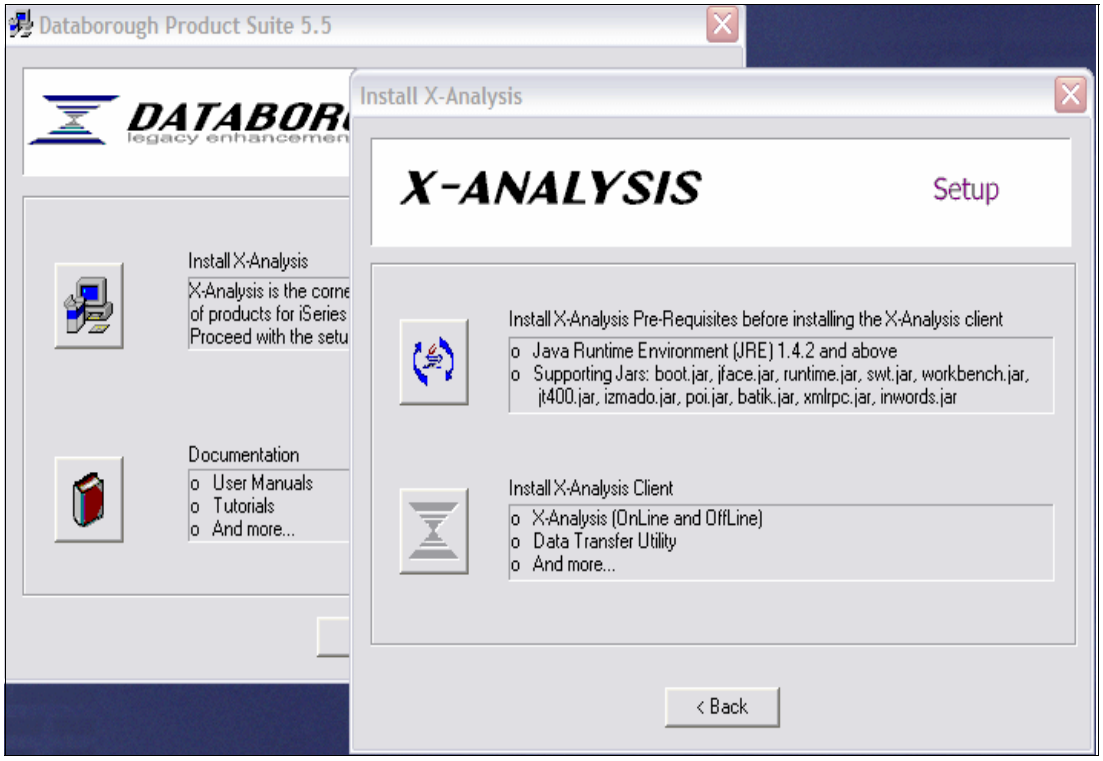

Figure A-2 Client install prerequisite

3. Click **Next** on the Required Prerequisite window to install the JRE and the JAR files.
4. Click **Next** on the X-Analysis Prerequisite Setup window, which identifies the missing prerequisites.

5. When the prerequisite install is complete, the X-Analysis Pre-Requisite Setup window indicates that the missing components have been installed (Figure A-3). The Action column in the PreRequisites table identifies the status of components installed. Click **Finish** to complete the X-Analysis client installation.

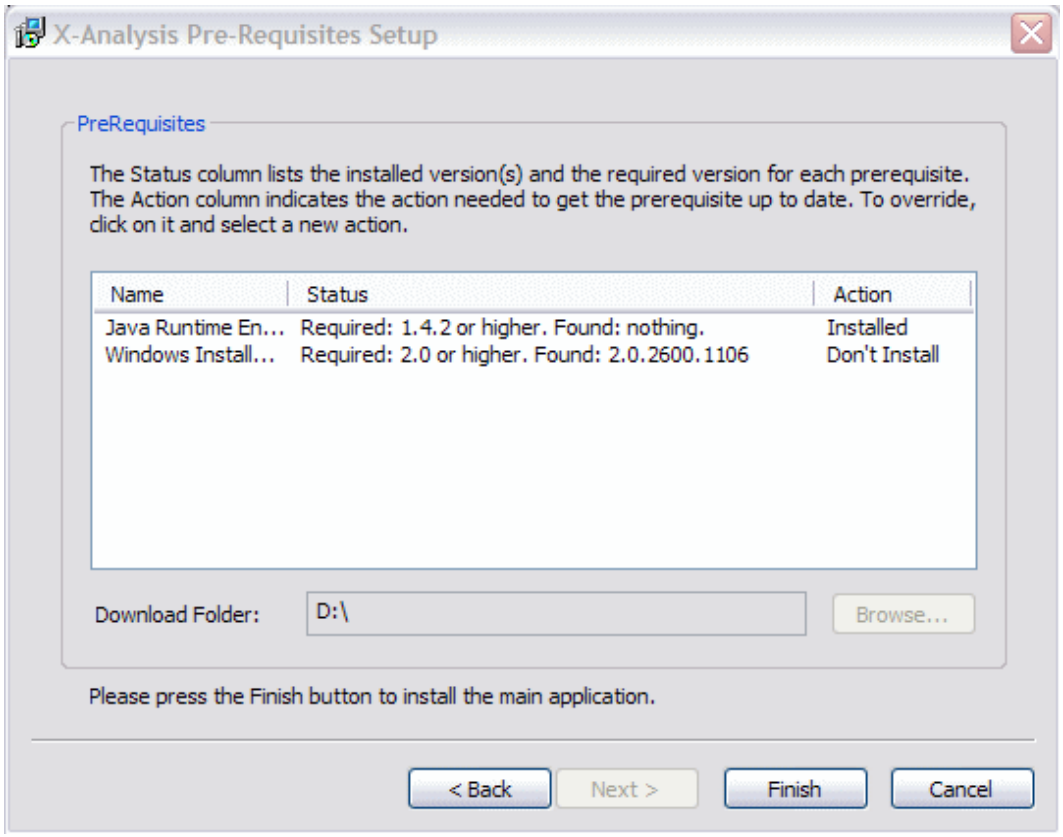
X-Analysis Pre-Requisites Setup
PreRequisites
The Status column lists the installed version(s) and the required version for each prerequisite. The Action column indicates the action needed to get the prerequisite up to date. To override, click on it and select a new action.
Name
Status
Action
Java Runtime En...
Required: 1.4.2 or higher. Found: nothing.
Installed
Windows Install...
Required: 2.0 or higher. Found: 2.0.2600.1106
Don't Install
Download Folder:
D:\
Browse...
Please press the Finish button to install the main application.
< Back
Next >
Finish
Cancel

Figure A-3 Prerequisites installed

6. On the X-Analysis PreRequisite Setup wizard, click **Next**.
7. On the Select Installation Folder window, you can specify the location of the X-Analysis software. We used the default folder provided (C:\Program Files\Databorough). Click **Next**.
8. On the Read to Install window, click **Install**.
9. On the Completing the X-Analysis PreRequisite Setup Wizard window, click **Finish** to exit this portion of the setup wizard.

Installing the X-Analysis client

The following steps are used to install the X-Analysis software on the client:

1. To start the installation, click the **Install X-Analysis** icon on the initial Databorough install window (Figure A-4).

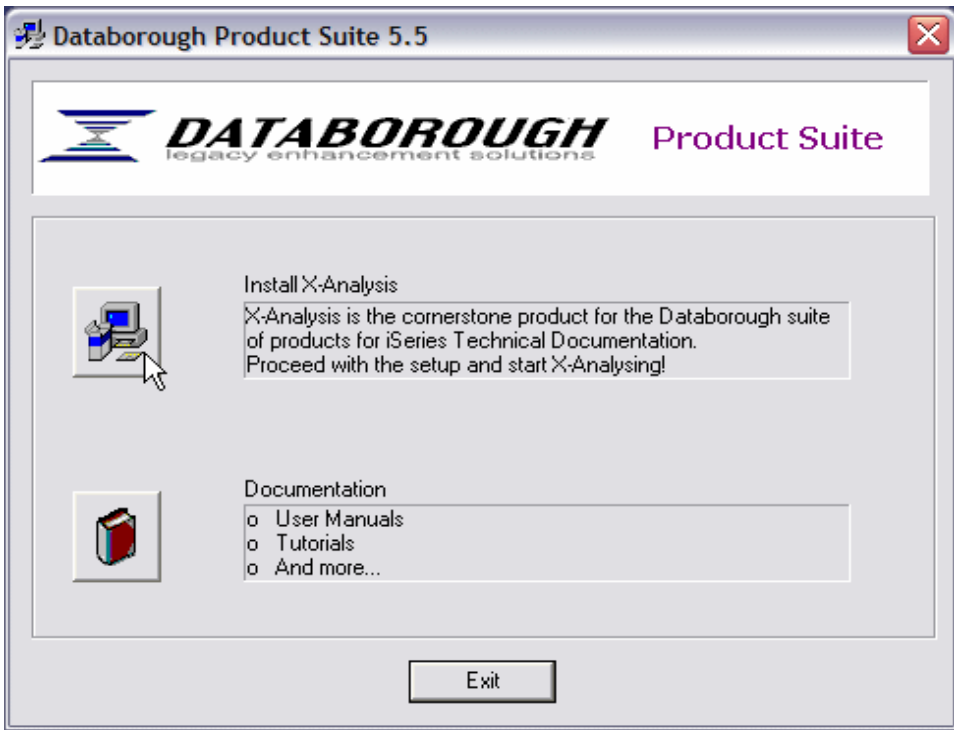

Figure A-4 Main install window

2. On the X-Analysis Setup window, click the **Install X-Analysis** icon.
3. Click **Next** on the Welcome to X-Analysis Setup Wizard.
4. Click **Install** on the X-Analysis Setup (Ready to Install) window.
5. On the Completing the X-Analysis Setup Wizard window, click **Finish** to exit the setup wizard.
6. If you want to install the product documentation, the Databorough Product Suite is still active, either click the Documentation icon (to install the documentation) or click Exit to end the program. We chose to click **Exit** to end the program.

Configuring X-Analysis on the client

Before you can use X-Analysis, it must be configured by performing the following steps:

1. To start the configuration on your PC, select **Start** → **Programs** → **X-Analysis** → **X-Analysis Configurator**.

2. On the X-Analysis Configurator window (Figure A-5), keep the default values and click **OK**.

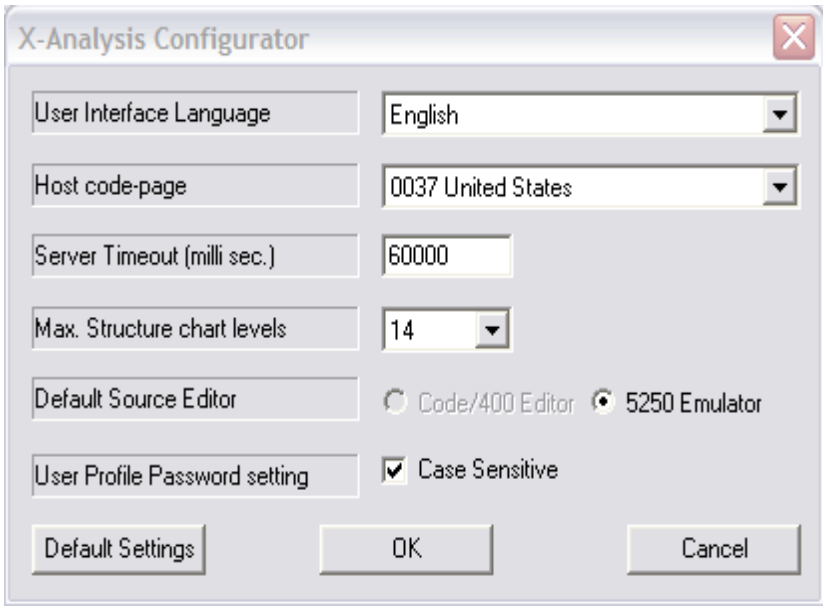

Figure A-5 Configure X-Analysis Client

Loading the Customer Management System on the iSeries

The Customer Management System (our sample application) is installed on the iSeries in a separate activity. The Copy From Stream File (CPYFRMSTMF) command is used to copy the Customer Management System to the iSeries. The command we used to load the application to our iSeries is:

```
CPYFRMSTMF FROMSTMF('/PATTERSON/FTP/XRAPPS/XRAPPS/')
TOMBR('/QSYS.LIB/QTEMP.LIB/XRAPPS.FILE/') MBROPT(*REPLACE)
```

Note: The FROMSTRMF file should reflect the location of the XRAPPS library in your system environment. The TOMBR should reflect the location you want to place the XRAPPS library on your iSeries.

After the CPYFRMSTMF command is complete, restore the library using the RSTLIB command:

```
RSTLIB SAVLIB(XRAPPS) DEV(*SAVF) SAVF(QTEMP/XRAPPS)
```

Creating a cross-reference repository for the Customer Management System

Attention: This section shows how to create the CMSXV1 cross-reference repository. These instructions are intended to show the necessary steps to create a cross-reference repository, which can be used to create other repositories used in other chapters.

This paper uses the Customer Management System for the sample application. After you have signed on the iSeries, use the following steps to initialize the application to X-Analysis:

1. Change the library list to place the X-Analysis library at the beginning of the list:
   a. On the command line, enter:

```
EDTLIBL
```

b. Add the new library XAN4 at Sequence Number 000.

c. Press Enter. Figure A-6 shows the results.

```
Edit Library List
                                                          System:   RCHAS12
Type new/changed information, press Enter.

Sequence                  Sequence                  Sequence
 Number   Library           Number   Library          Number   Library
     0                       150                       300
    10    XAN4              160                       310
    20    QGPL              170                       320
    30    QTEMP             180                       330
    40                      190                       340
    50                      200                       350
    60                      210                       360
    70                      220                       370
    80                      230                       380
    90                      240                       390
   100                      250                       400
   110                      260                       410
   120                      270                       420
   130                      280                       430
   140                      290                       440
                                                                  More...
F3=Exit   F5=Refresh   F12=Cancel
Library list changed.
```

Figure A-6 Add XAN4 to library list

2. On the command line, enter the X-Analysis command:

```
X4WRKAPP
```

3. The Work with X-Analysis Application displays (Figure A-7). To add a new cross-reference repository, press F6 (Add).

```
X-Analysis/4          Work with X-Analysis/4 Applications    Databorough Ltd.
XARWKAPP                                                            12:10:31
                                                                 13 Sep 2005
Enter options, press Enter.
1=Authorities 2=Change 3=Copy 4=Delete 5=Display 7=Notes 8=Libraries
9=Variable Calls 10=App areas 11=Reports 12=Initialise 13=Build data model
14=Offline menu 15=Objects 16=Exclusions 17=I/F Files 18=Program standards

   X-ref Lib   Text                            Company/division


   XAN4CDXA    Tutorial Application



F1=Help   F3=Exit  F6=Add    F10=Cmd Line      F12=Cancel   F24=More Keys
```

Figure A-7 Work with X-Analysis Applications

4. Enter the following information about your new cross-reference repository:

   – X-ref Library (the name of your new cross-reference repository); we entered CMSXV1.

- Text (a brief description; we entered `CMS x-ref version 1`.
- For Company/division, we entered ITSO.
- For Index source files, enter `A` for All.
- For Process var & bound calls, enter `Y` (Yes).

Press Enter.

```
X-Analysis/4          Work with X-Analysis/4 Applications    Databorough Ltd.
XARWKAPP                                                             15:26:12
                                                                  13 Sep 2005

 X-ref Library. . . . . . . . .    CMSXV1
 Text . . . . . . . . . . . . .    CMS x-ref version 1
 Company/division . . . . . . .    ITSO
 Index src files. . . . . . . .    A
 Process var & bound calls. . .    Y
 Include obsolete source  . . .
 Build data model . . . . . . .
 Data model match value   . . .
 TCPIP address  . . . . . . . .
 User iD  . . . . . . . . . . .

F1=Help        F3=Exit        F12=Cancel
```

Figure A-8 Create a cross-reference repository

5. The new cross-reference repository is added to the application library list. You see the message `Application Added` on the Work with X-Analysis/4 Applications screen.
6. To assign the source and object libraries, select option `8` (Libraries) beside CMSXV1.
7. To add the source and object libraries for the CMS application:
   a. Press F6 (Add) to get the detail screen. To add the Source (on the Work with X-Analysis/ 4 Application Libraries detail screen), enter the following:
      i. Type is `S` (source).
      ii. Sequence is `1.00`.
      iii. Library is `XRAPPS`.
      iv. Press Enter. The Work with X-Analysis/4 Application Libraries screen appears with the source library added. At the bottom of the screen you see the message `Record Added`.
   b. Press F6 (Add) to get the detail screen. To add the Object (on the Work with X-Analysis/4 Application Libraries detail screen), enter the following:
      i. Type is `O` (object).
      ii. Sequence is `1.00`.
      iii. Library is `XRAPPS`.
      iv. Press Enter. The Work with X-Analysis/4 Application Libraries screen appears with the object library added. At the bottom of the screen you see the message `Record Added`.

   Figure A-9 shows both the source and object library added to the cross-reference repository.

8. Press F12 (Cancel) to return to the main Work with X-Analysis/4 Application Libraries screen.

```
X-Analysis/4   Work with X-Analysis/4 Application Libraries   Databorough Ltd.
XARWKLIB                                                            15:39:47
                                                                 13 Sep 2005
Selected x-ref Library -> :   CMSXV1

Enter options, press Enter.
2=Change    4=Delete    5=Display

   Type Sequence Library

   S      1.00   XRAPPS
   O      1.00   XRAPPS

F1=Help        F3=Exit        F6=Add         F12=Cancel     F16=Print
```

Figure A-9 XRAPPS source and object libraries are added

Initializing the cross-reference repository for the Customer Management System

To initialize the cross-reference repository for the Customer Management System, perform the following steps:

1. On the Work with X-Analysis/4 Application screen, select option 12 (Initialize) next to the CMSXV1.
2. On the Initialise X-Analysis/4 screen (Figure A-10), press Enter.

```
Initialise X-Analysis/4 (XA4INITP)

Type choices, press Enter.

Library for X-Ref database . . . > CMSXV1        Name
Submit job . . . . . .           *YES          *YES, *NO

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure A-10 Initialize the application model

3. On the Initialise X-Analysis/4 detail screen (Figure A-11), accept the default values. Press Enter to submit a batch job.

```
Initialise X-Analysis/4 (XA4INIT)

Type choices, press Enter.

X-Analysis Library . . . . . > CMSXV1        Name
Object Libraries . . . . . > XRAPPS        Name
              + for more values
Source Libraries . . . . . > XRAPPS        Name, *NONE
              + for more values
Index Source Files . . . . . > *ALL          *CHG, *NO, *ALL, *UPG
Include obsolete source  . . . .   *NO          *YES, *NO
Process variable & bound CALLS   > *YES         *YES, *NO, *ALL, *SRC
Non AS/400 Code TCPIP Address  .   *NONE



                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure A-11 Details of batch job

You are returned to the Work with X-Analysis/4 Applications screen. You see the message `Job successfully submitted`.

Generating the data model for the Customer Management System

To create a data model for the Customer Management System, perform the following steps:

1. On the Work with X-Analysis/4 Applications screen, select option `13` (Build data model) beside CMSXV1.
2. On the Initialise Data Model screen (Figure A-12), accept the defaults and press Enter.

```
Initialise Data Model (XDMODELP)

Type choices, press Enter.

Library for X-Ref database . . . > CMSXV1        Name
Submit job . . . . . .   *YES          *YES, *NO

                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure A-12 Submit batch job for creating the data model

3. On the Generate Prototype Application (XDMODEL) screen (Figure A-13), accept the default values and press Enter.

```
Generate Prototype Application (XDMODEL)

Type choices, press Enter.

Function Library . . . . . > CMSXV1        Name
Add/replace model data . . . . .   *REPLACE      *ADD, *REPLACE
Site Library . . . . . .   *FUNLIB       Name, *FUNLIB
Add/replace site data  . . . . .   *REPLACE      *ADD, *REPLACE
Function type  . . . . . > *GRIDS        *GRIDS, *LISTS, *NONE
X-Analysis Application Area  . .   *ALL          Name, *ALL
Data Libraries . . . . . > XRAPPS        Name
              + for more values
Synon Model Libraries  . . . . .   *NONE         Character value, *NONE
              + for more values
Derive Foreign Keys  . . . . . > *PGMLOGIC     *DATABASE, *DATABASEA...
Tolerance Value  . . . . . .   *NOMAX        Number, *NOMAX
Allow unmatched field names  . .   *PREFIX       *ALL, *PREFIX, *PREFIX3...
Use ref. fields for deriving . .   *NO           *NO, *EXACT, *PREFIX, *SUFFIX
Use field texts for deriving . .   *NO           *AND, *OR, *NO
Overrides Library/Diagrammer . .   *DGM          Name, *DGM, *FUNLIB
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure A-13 Verify job details

On the Work with X-Analysis/4 Libraries screen, you see the message `Job successfully submitted`.

Giving designer authority

In order to work with the cross-reference repository, you must be authorized. On the Work with X-Analysis/4 Applications screen, perform the following steps to get authorized:

1. Select option `1` (Authorities) for CMSXV1.
2. On the Work with Authorities screen, press F6 (Add) to add your user information.
3. On the Work with Authorities detail screen (Figure A-14), enter the following information:
   a. For User profile, enter your user ID. We entered `LINDAMAY`.
   b. For Designer, enter `Y` (yes) to give yourself designer authority.
   c. For Allow to change Help Text, enter `Y` (yes).
   d. For Design level, enter `A` (All).
   e. For Security level enter `A` (All).
   f. Press Enter.

```
X-Analysis                  Work with Authorities              Databorough Ltd.
XARWKAUT                                                              14:20:39
                                                                  13 Sep 2005

 User profile . . . . . .    LINDAMAY
 Designer . . . . . . . .    Y
 Allow to change Help Text   Y
 Design level . . . . . .    A
 Security level . . . . .    A


F1=Help  F3=Exit  F12=Cancel
```

Figure A-14 Give user authority

On the Work with Authorities main screen, you see the message `Record Added`.

Accessing X-Analysis on your PC

Use the following steps to sign on to the X-Analysis client installed on your PC and view the model we created previously.

1. To start X-Analysis on your PC select **Start** → **Programs** → **X-Analysis** → **X-Analysis (OnLine)**.
2. On the Sign on to X-Analysis pop-up (Figure A-15) enter the following information:
   a. The Host Name is the TCP/IP address of your iSeries.
   b. The Username is your user ID.
   c. The Password is your password.
   d. Click **OK**.

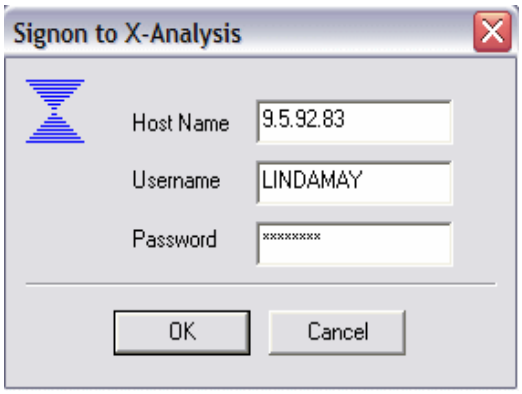

Figure A-15 Start X-Analysis (sign on)

3. The X-Analysis List of Application Libraries window appears, displaying the available repositories (Figure A-16).

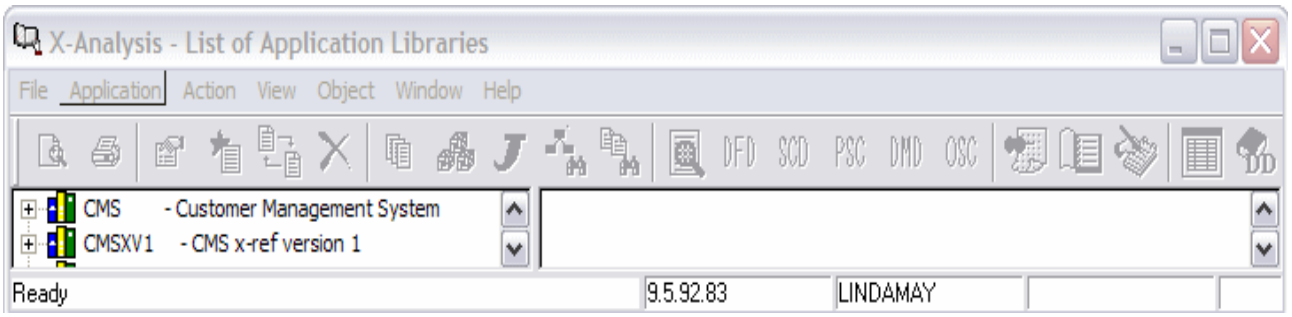
X-Analysis - List of Application Libraries
File Application Action View Object Window Help
DFD SCD PSC DMD OSC DD
CMS - Customer Management System
CMSXV1 - CMS x-ref version 1
Ready
9.5.92.83
LINDAMAY

Figure A-16 View CMSXV1 model

4. To expand the model to see the details, click the plus sign (+) beside CMSXV1. Figure A-17 shows the various types of components contained within the model. To explore the model further, you can double-click any of these components.

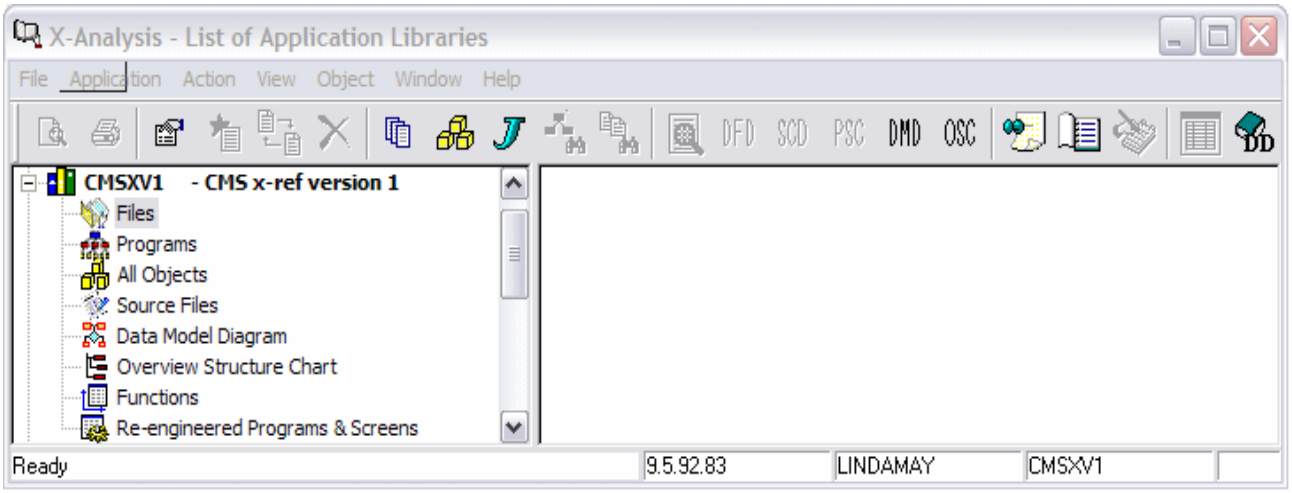

Figure A-17 View CSMV1 detail

Installing the X-Web Server and Apache Tomcat

To execute a re-engineered Web-enabled application, a Web server is required. The X-Analysis CD includes the X-Web Server and the Apache Tomcat servlet container. Before you can use the X-Web Server and Apache Tomcat, you must install them on your PC by performing the following activities:

- Unzip the installer to your PC.
- Run the setup utility.
- Install Apache Tomcat.
- Install the X-Web server.

The X-Web Server installer is a zipped file on the X-Analysis installation CD. Perform the following steps for the installation:

1. On your PC, create a new directory within the Program Files directory, as follows:
   a. Open an Explorer window.

b. Expand the C: drive.

c. Select the **Program Files** → **Databorough** directory.

d. Create a new folder and name it `X-Web Server`.

2. Copy and unpack the X-Web installation file using the following steps:

a. Insert the X-Analysis installation CD in your CD drive.

b. Open the root directory of the CD and locate the X-Web_5.6.7.zip file.

c. Copy the zip file to the X-Web Server folder.

d. Unpack the zip file into the X-Web Server folder.

3. Run the X-Web Server setup utility, as follows:

a. Locate and run the **Setup.exe** file located in the X-Web Server folder.

b. On the installation mode dialog box, select **Full Installation**.

c. Click **OK**.

4. The X-Web Server setup utility installs the Apache Tomcat servlet container, as follows:

a. In the Apache Tomcat Installer dialog box (Figure A-18), set the X-Web Server port field to `80`.

b. Leave the remaining fields at the defaults.

c. Click **OK**.

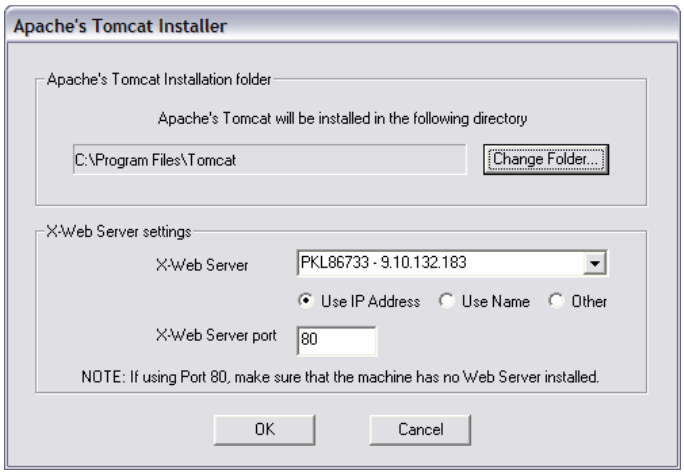

Figure A-18 Apache Tomcat Installer

d. When the installation of Apache Tomcat is complete, a dialog box appears with the message `Apache's Tomcat has been successfully installed`. Click **OK**.

5. The X-Web Server setup utility next installs the X-Web Server by performing these steps:

a. Review the X-Web End User License Agreement. Click **Next** to accept and continue the installation.

b. Leave the installation parameters at the default values. Click **Next** to start the install.

c. X-Web Server installation begins. When the X-Web installation dialog box displays the message `Installation completed`, click **Finish** to complete the installation. The X-Web Server installation setup utility displays pop-up messages as it copies utilities, sets up shortcuts, and installs registry entries.

d. When the installation is complete, the X-Web Installation dialog box appears with the following essential status information (there may be additional messages particular to your PC):

```
The machine has following components:
>  Sun's Java Runtime Environment
>  Apache's Tomcat WebServer
>  Databorough's X-Browse
>  Databorough's X-Web
```

e. Click **OK t**o exit the installation.

B

X-Analysis cross-reference repository details

This appendix contains detailed information about the X-Analysis cross-reference repository. You can use this information to create programs to access the repository for your own purposes. Most of the files are described in detail; the only omissions are temporary work files and files used to format data areas.

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X-Analysis system wide data

The X-Analysis systemwide data is stored in the X-Analysis product library XAN4. It contains information shared across all applications.

Table B-1 X-Analysis systemwide data

Table name	Description
XA4APPLS	X-Analysis Application X-Ref Libraries contains one record for each X-Analysis cross-reference repository. It has narrative data and defaults for the command XA4INIT held against each cross-reference repository.
XAALIBL	Cross-Reference Repository Load Libraries contains one record for each library loaded in a cross-reference repository. It stores the load library, library type, and sequence against the cross-reference repository.

Application cross-reference repository data

Table B-2 shows the files particular to each X-Analysis application library. These files are located in the X-Analysis cross-reference repository. The command XA4INIT is used to create a cross-reference repository and load specified object and source libraries.

Application data

The application data describes the components of each application loaded into X-Analysis.

Table B-2 X-Analysis application load data

Table name	Description
XOBJECT	List of objects; has a record for each object in the application libraries.
XPFSRC	List of source files; has a record for each source file in the application libraries.
XMEMBER	List of members; has a record for each member in each of the source files.
XVOBJECT	List of objects in variant libraries
XBOBJECT	Join logical file over XBOBJECT and XVOBJECT to include all loaded objects.

Overrides

The tables in Table B-3 are used to override X-Analysis defaults. The data may be entered or changed by the user or automatically generated by the system load.

Table B-3 X-Analysis override data

Table name	Description
XSTANDARDS	Program Standards can be derived automatically or entered by the user by calling program XARWKSTD.
XLSCDEXC	Program Exclusions consists of excluded programs not to appear in structure chart diagrams, dataflow diagrams, object where used outputs, or application areas.
XNSFN	Non-standard Source Files
XNSSTYPES	Non-standard Source Types

Table name	Description
XPGREXCS	Program Reference Exclusions; has programs such as APIs like QCMDEXC that are excluded from referencing.
XSRCPFEX	Source file exclusions
XCMDEXCLS	Command exclusions
XAXGENFILS	Generic file data
XAXGENPGMS	Generic program data

User control data

The tables in Table B-4 enable you to manipulate the application library into application areas. Many X-Analysis commands run on an application area. Projects that utilize this information could run for specific areas rather than the entire application.

Table B-4 X-Analysis user control data

Table name	Description
XAADESC	Application Area Descriptions
XAALIST	Application Area Objects
ARULES	Application Area Rules

Object data

The tables in Table B-5 are derived from the object by using standard IBM commands or APIs.

Table B-5 X-Analysis object data

Table name	Description
X@XPGRF	Program Object References
X@XDBR	Database relations
X@XRFMT	Record Format Data
XLFFD	File Field Data
XLBASATR	Object Attribute Data
XTRIGGERS	Trigger Data
XJOURNALS	Journal Data
XCONSTRTS	Constraint Data
XADDMFILS	DM File Data
XAXCPP	CMD Processor Data
XAXCVCP	CMD Validity Checker Data
XAXMENU	Menu Data
XVCONSTRTS	Variant Library Constraint Data

Table name	Description
XVTRIGGERS	Variant Library Trigger Data
XVXPGRF	Variant Library Program Object References. There are variant versions of all programs that populate X@XPGRF.

Table X@XPGRF

Table X@XPGRF contains objects referenced by programs, commands, and menus. These references are retrieved primarily from object data. However, the source is also interpreted for additional references.

X@XPGRF and its equivalents (XVXPGREF and XPROCREF) are used to:

- Provide comprehensive Object Where Used data.
- Allow complete investigation of program references.

Table B-6 X@XPGRF file layout

Field name	Datatype	Length	Description
WHPNAM	CHAR	10	The name of the program, CMD or MENU
WHTEXT	CHAR	50	The text held against WHPNAM
WHFNAM	CHAR	11	The name of the referenced object
WHOBTP	CHAR	1	The referenced object type: P - Program F- File D - Data Area C - Command
WUSAGE	CHAR	1	The object type usage: I - Input File U - Update/Input File O - Output File A - Input and Output File B - Input and Output and Update File C - Command calls command processing program V - Command calls validity checking program I - Program calls program or calls command T - Trigger program input file S - Trigger program update file

Notes: Remember:

- The object type of the WHPNAM field may be implied by the value of the WUSAGE. This is important when an object such as a program and a command have the same name. When WUSAGE = C or V, the WHPNAM object type is command; otherwise the WHPNAM object type is a program.
- Program in this case may indicate either a *PGM object or a *SRVPGM object.
- XVXPGREF is the equivalent file for variant libraries.
- XPROCREF is the equivalent file for OCL.

The exclusion file XPGREXCS is used to exclude program, service program, and (replaced) variable program calls from being written to the file. The exclusion file XLSCDEXC is used to exclude referenced objects at execution time when the data is retrieved.

Table X@XDBR

X@XDBR contains file dependencies between tables in the database. The file is built from the DSPDBR command and is used to retrieve physical files for logical files and vice versa.

Table B-7 X@XDBR file layout

Field name	Datatype	Length	Description
WHRFI	CHAR	10	The file name
WHREFI	CHAR	10	The dependent file name
WHTYPE	CHAR	1	The dependency type: D - Data I - Access path O - Access path owner V - SQL view

Table X@XRFMT

This table contains details of record formats within files.

Table B-8 X@XRFMT file layout

Field name	Datatype	Length	Description
RFFILE	CHAR	10	File name
RFNAME	CHAR	10	Record format name
RFFTYP	CHAR	1	File type: P - Physical file L - Logical file D - Device file
RFTYPE	PACKED	1,0	Record format type: 1 - Normal 2 - SFL 3 - SFLMSGRCD 4 - SFLCTL 5 - USEDFN

The data originates from DSPFD TYPE(*RCDFMT) and is used to:

- Identify file from format.
- Identify display file format type.

Source cross-reference data

Source member data is derived by cross-referencing the source code.

Table B-9 X-Analysis source member data

Table name	Description
XAGWU	Source member index
XAGCBO	COBOL overlays

Table name	Description
XAGCBQ	COBOL qualifiers
XAXPGREF	Program references from source
X@XCPYB	/COPY references by member
X@XDSPF	Device files by member
X@XPRXM	Procedures by member
XAXPROTO	Prototypes by member
XAXFMTR	Format renames by member
XRFPREFX	Field renames by member
XAXMFF	File/format name/rename by member
XAFALIAS	Field aliases
XPROCREF	OCL procedure references
XCLOVRS	CL overrides
XCONCATS	Field concatenation data
XVPGREF	Program references from variant source

The files in Table B-10 are lists of source members.

Table B-10 Lists of source members

Table name	Description
XLSRCMBR	Source Member Data
X4MEMBER	Source Member Index Control

Table XAGWU

XAGWU (X-Analysis Where Used Data) is an index of each significant word in each source member with an allowable source type. The source member details are stored (library, file, member, type, relative record number (RRN)) together with the variable name, type, and whether modified. When used with alias and rename data, this enables instant cross-referencing of any variable type or constant against the entire application.

To retrieve an occurrence of a variable, use the source member details to open the source file member, then use the RRN to retrieve the individual source record. Use a standard procedure to interpret the source line. The source file attribute (VATTR) determines which standard procedure is used to interpret the source. For COBOL, the field sequence no. (VVARSQ) allows determination of the specific occurrence of the field in the statement. Where statements extend over several source lines, standard procedures are used to build the complete statements, reading both backward and forward through the source member.

Table B-11 XAGWU file layout

Field name	Datatype	Length	Description
VSRCLB	CHAR	10	Source library
VSRCFL	CHAR	10	Source file

Field name	Datatype	Length	Description
VSRCMB	CHAR	10	Source member
VOBTY	CHAR	2	Variable type: AA - Start of program logic section CL - Called program CN - Constant/literal EF - Externally defined data structure IN - Indicator PI - Procedure interface definition SR - Start of ILE RPG subroutine, COBOL section, or paragraph
VRECN	PACKED	5,0	RRN where the variable occurs in the source member
VMOD	CHAR	1	Indicates whether the variable is modified or not - if relevant
VATTR	CHAR	2	Indicates the source member attribute: CL - CL variant (CLP, CL, CLLE) RG - RPG variant (RPG, RPG38, SQLRPG) RI - RPGLE variant (RPGLE, SQLRPGLE) CB - COBOL variant (CBL) PF - PF variant LF - LF variant DS - DSPF variant PR - PRTF variant OC - OCL SQ - SQL US - User Space AL - Alias only record (allows references to a variable to be retrieved when it only occurs as an alias in a source member)
VVARSQ	PACKED	5,0	The sequence number (position) of the variable within the source statement (or the part of it that is on the source line if the statement extends over more than one line). This only applies to COBOL and free-format ILE RPG.

Table X@XCPYB

X@XCPYB holds details of /COPY references within source members

Table B-12 X@XCPYB file layout

Field name	Datatype	Length	Description
PGMMBR	CHAR	10	The source member containing the reference
PGMFIL	CHAR	10	The source file containing the source member
PGMLIB	CHAR	10	The library containing the source file
CPYMBR	CHAR	10	The source member referenced by /COPY
CPYFIL	CHAR	10	The source file containing the referenced source member
CPYLIB	CHAR	10	The library containing the referenced source file

Restriction: The CPYFIL and CPYLIB fields cannot be relied on to contain values. The program X@RSRCF can be called to ensure that the correct values are retrieved.

Table X@XDSPF

Table X@XDSPF holds references to device files by source member.

Table B-13 X@XDSPF file layout

Field name	Datatype	Length	Description
PGMMBR	CHAR	10	The source member containing the reference
PGMFIL	CHAR	10	The source file containing the source member
PGMLIB	CHAR	10	The library containing the source file
DSPMBR	CHAR	10	Is the source member of the device file
DSPFIL	CHAR	10	The source file containing the referenced source member
DSPLIB	CHAR	10	The library containing the referenced source file

Restriction: The DSPFIL and DSPLIB fields cannot be relied on to contain values. The program X@RSRCF can be called to ensure that the correct values are retrieved.

Table X@XPRXM

Table B-14 table contains ILE RPG procedures by Member.

Table B-14 X@XPRXM file layout

Field name	Datatype	Length	Description
PRXMBR	CHAR	10	The source member containing the procedure
PRXFIL	CHAR	10	The source file containing the source member
PRXLIB	CHAR	10	The library containing the source file
PRXPR	CHAR	50	Has the name of the procedure

The cross-indexing process also writes records to XAXPROTO. This contains the prototype name versus the exported procedure name. These two files enable the tracking of prototyped procedures and programs.

Derived data

The tables in Table B-15 are derived by X-Analysis from the source and object data.

Table B-15 X-Analysis derived data

Table name	Description
XAXFLOW	Program flow data
XAXPFLOW	Procedure flow data
XAXSCD	Program SCD data
XLTXT	Program narratives
XLENC	Encyclopedia - Data modelling diagram interface

Note: A Global Where Used Workfile named XAGWUWK has no file layout information.

C

Additional material

This Redpaper refers to additional material that can be downloaded from the Internet as described below.

Locating the Web material

The Web material associated with this Redpaper is available in softcopy on the Internet from the IBM Redbooks Web server. Point your Web browser to:

ftp://www.redbooks.ibm.com/redbooks/REDP4046

Alternatively, you can go to the IBM Redbooks Web site at:

ibm.com/redbooks

Select the **Additional materials** and open the directory that corresponds with the Redpaper form number, REDP4046.

Using the Web material

The additional Web material that accompanies this Redpaper includes the following files:

File name	*Description*
LIBRARYCMS.savf	Sample library containing the sample application used in this paper. This library is for V5R2 of OS/400 or V5R3 of i5/OS.
CMS project.zip	Sample Web project for the MVC re-engineering project.
xrefexampl.savf	Sample ILE RPG source code that demonstrates how the X-Analysis Cross-Reference Repository can be used.

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System requirements for downloading the Web material

The following system configuration is recommended:

Hard disk space	190 MB minimum
Operating System	Windows 2000 Professional
Processor	Pentium® III or higher
Memory	512 MB

How to use the Web material

To use the Web material, follow the instructions in this section.

Restoring the LIBRARYCMS.SAVF

Send by File Transfer Protocol (FTP) the libraryCMS.savf file to the iSeries server using the following example:

1. Create a save file in your library on the iSeries:

```
CRTSAVF QGPL/LIBRARYCMS
```

2. Transfer the downloaded save file to your iSeries library:

```
C:\>ftp yoursystem
Connected to yoursystem.yourdomain.com.
220-QTCP at yoursystem.yourdomain.com.
220 Connection will close if idle more than 5 minutes.
User (yoursystem.yourdomain.com.:(none)): youruserid
331 Enter password.
Password:yourpassword
230 youruserid logged on.
ftp> bin
200 Representation type is binary IMAGE.
ftp> put c:\yourDir\librarycms.savf /qsys.lib/qgpl.lib/librarycms.savf
200 PORT subcommand request successful.
150-NAMEFMT set to 1
150 Sending file to member LIBRARYCMS in the LIBRARYCMS in library your library.
250 File Transfer completed successfully.
```

3. End the FTP session by entering **quit**.
4. Sign on to the iSeries server and restore the save file:

```
RSTLIB SAVLIB(LIBRARYCMS) DEV(*SAVF) SAVF(QGPL/LIBRARYCMS) RSTLIB(XRAPPS)
```

Installing the CMS MVC re-engineering Web project

Follow these steps to install the application:

1. From the WebSphere Development Studio Client for iSeries tool bar, click **File** → **Import**.

2. On the Import window (Figure C-1), select **Project Interchange Format** and click **Next**.

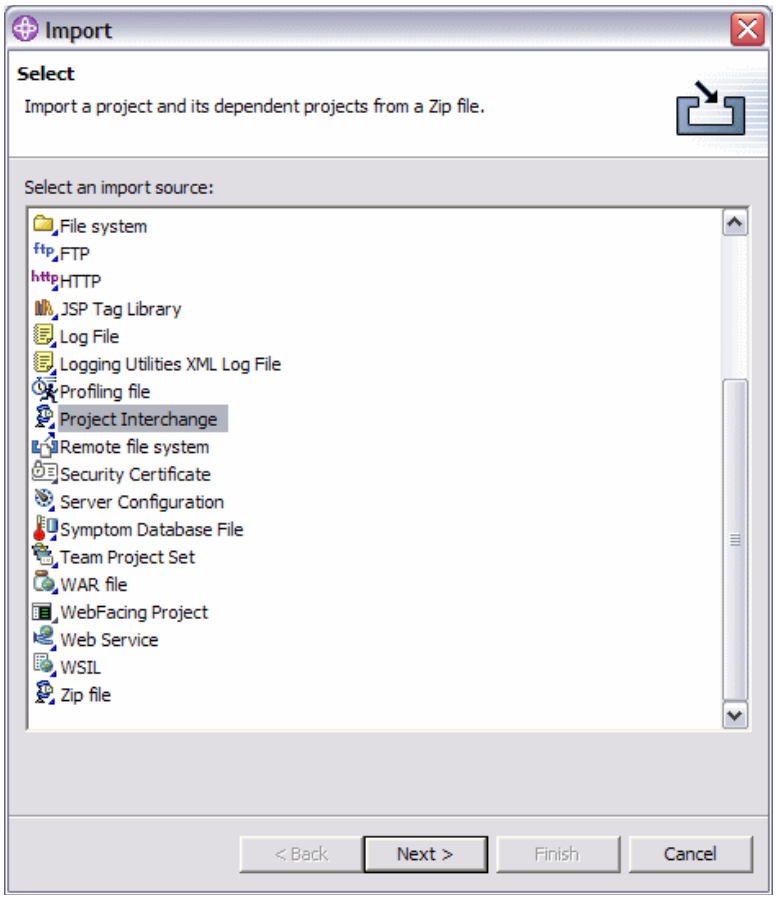

Figure C-1 Import project into WDSc

3. On the Import Project Interchange Contents dialog box (Figure C-2), complete the following steps:
   a. Click **Browse** beside the “From zip file” field and select the **CMS project.zip**.
   b. Select the **Cms** check box.
   c. Click **Finish**.

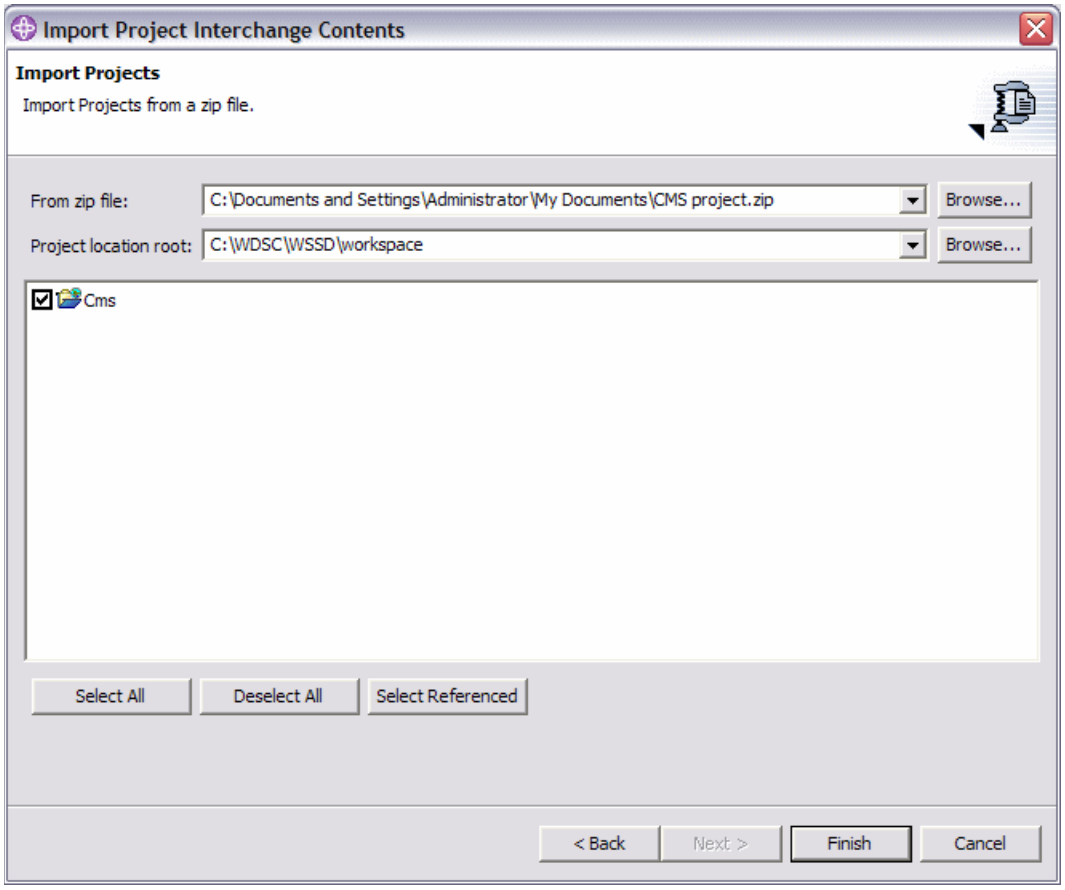

Figure C-2 Import Project Interchage Contents dialog box

4. The project loads into WDSc. Select **Window** → **Open Perspective** → **Web** to open the Web perspective and review the project.

Restoring the xrefexampl.savf library

You need to send by File Transfer Protocol (FTP) the xrefexampl.savf file to the iSeries server using the following example:

1. Create a save file in your library on the iSeries:

```
CRTSAVF QGPL/XREFEXAMPL
```

2. Transfer the downloaded save file to your iSeries library:

```
C:\>ftp yoursystem
Connected to yoursystem.yourdomain.com.
220-QTCP at yoursystem.yourdomain.com.
220 Connection will close if idle more than 5 minutes.
User (yoursystem.yourdomain.com.:(none)): youruserid
331 Enter password.
Password:yourpassword
230 youruserid logged on.
ftp> bin
200 Representation type is binary IMAGE.
ftp> quote site namefmt 1
250  Now using naming format "1".
ftp> put c:\yourDir\xrefexampl.savf /qsys.lib/qgpl.lib/xrefexampl.file
200 PORT subcommand request successful.
150 Sending file to member XREFEXAMPL in file XREFEXAMPL in library QGPL.
250 File transfer completed successfully.
```

3. End the FTP session by entering `quit`.
4. Sign on to the iSeries server and restore the save file:

```
RSTLIB SAVLIB(XREFEXAMPL) DEV(*SAVF) SAVF(QGPL/XREFEXAMPL) RSTLIB(XREFEXAMPL)
```

   Two objects are restored to library XREFEXAMPL:

   - **QRPGLESRC:** Contains the example source member XREFEXAMPL
   - **XREFEXAMPL:** Program object

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this Redpaper.

IBM Redbooks

For information on ordering these publications, see “How to get IBM Redbooks” on page 273. Note that some of the documents referenced here may be available in softcopy only.

- *Modernizing IBM @server iSeries Application Data Access - A Roadmap Cornerstone*, SG24-6393
- *WebSphere Development Studio Client for iSeries Version 5.1.2*, SG24-6961
- *WebSphere Development Studio Client for iSeries: Bringing New Life into 5250 Applications, SG24-6600*
- *Managing Information Access to an Enterprise Information System Using J2EE and Services Oriented Architecture, SG24-6371*
- *Patterns: Implementing an SOA using an Enterprise Service Bus*, SG24-6346
- *Patterns: SOA with an Enterprise Service Bus in WebSphere Application Server V6*, SG24-6494
- *Student Edition: WebSphere Development Studio Client for iSeries V5.0, SG24-7086*
- *Enabling Web Services for the IBM @server iSeries Server, REDP-0192*
- *IBM @server i5 and iSeries System Handbook: IBM i5/OS Version 5 Release 3 October 2004*, GA19-5486
- *WebSphere for the IBM @server iSeries Server Buying and Selling Guide*, REDP-3646
- *Moving to Integrated Language Environment for RPG IV*, GG24-4358
- *Unleashing AS/400 Applications on the Internet*, SG24-4935
- *Who Knew You Could Do That with RPG IV? A Sorcerer's Guide to System Access and More*, SG24-5402
- *WebSphere Studio Application Developer Programming Guide*, SG24-6585
- *WebSphere Application Server V5 for iSeries: Installation, Configuration, and Administration*, SG24-6588
- *WebSphere Studio Application Developer Version 5 Programming Guide*, SG24-6957
- *WebSphere Application Server - Express V5.0 for iSeries*, REDP-3624

Other publications

These publications are also relevant as further information sources:

- *Java for RPG Programmers, Second Edition,* by George Farr and Phil Coulthard. Mc Press, April 2002, ISBN193118206X
- *VisualAge for RPG by Example,* by Bryan Meyers and Jef Sutherland. 29th Street Press, April 1998, ISBN 1882419839

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- *Experience RPG IV Tutorial,* by Heather Rogers and M. Masri. Advice Press, April 1999, ISBN 1889671223
- *Programming with VisualAge RPG*, SC09-2449
- *VisualAge RPG Parts Reference*, SC09-2450
- *VisualAge RPG Language Reference*, SC09-2451
- *iSeries Performance Capabilities Reference*, SC41-0607

Online resources

These Web sites and URLs are also relevant as further information sources:

- For more information about X-Analysis

  http://www.databorough.com/
- WebSphere Development Studio Client for iSeries information and help

  http://publib.boulder.ibm.com/infocenter/iadthelp/index.jsp
- iSeries Developer Roadmap

  http://www.ibm.com/servers/eserver/iseries/roadmap
- Technical support and resources for iSeries and AS/400

  http://www-912.ibm.com/
- Information about Model-View-Controller Architecture

  http://java.sun.com/blueprints/patterns/MVC.html
- JavaServer Faces

  http://java.sun.com/j2ee/javaserverfaces
- JavaBeans

  http://java.sun.com/products/javabeans/index.jsp
- Apache Tomcat

  http://jakarta.apache.org/tomcat
- Information about UML

  http://www.uml.org
- WebSphere Studio Site Developer

  http://www.ibm.com/software/ad/studiositedev
- WebSphere Studio Application Developer

  http://www.ibm.com/software/ad/studioappdev
- WebSphere Application Server Version 4.0 Advanced Edition for iSeries

  http://publib.boulder.ibm.com/was400/40/AE/english/docs
- iSeries Information Center

  http://www.ibm.com/eserver/iseries/infocenter

Online Tutorials

Several self study tutorials covering WDSc are available on the Internet:

- You can register for the Web-based Training Course SW738 *Introducing IBM WebSphere Development Studio Client for iSeries* at:

http://ibm.com/developerworks/websphere/library/tutorials/dl/sw738/

- There are also some tutorials provided with the online Help under *Tutorials and samples*. If you do not have WDSc installed on your workstation, you can also access the online help at:

  http://publib.boulder.ibm.com/infocenter/iadthelp/index.jsp

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Modernizing and Improving the Maintainability of RPG Applications Using X-Analysis Version 5.6

Redpaper

Graphically analyze application architecture

Extract business rule logic and application data models

Modularize existing code into the MVC architecture

This IBM Redpaper covers the use of X-Analysis to accelerate the modernization and improve the maintainability of existing RPG applications. It discusses how X-Analysis is used to restructure and reuse the RPG application's business logic and application data model, and includes step-by-step examples and scenarios showing an RPG application exposed by the tool. The paper shows how an application is visually displayed, starting from a high-level model and drilling down to program details such as the specific use of fields and files.

Use of X-Analysis to convert an existing application to the Model-View-Controller architecture is explained. In this instance, the View and Controller portions of the application are converted to JavaServer Faces and JavaBeans. X-Analysis takes advantage of the implicit data and process model in the application to create individually callable pieces of business logic.

This paper explores many of the capabilities available in X-Analysis and shows you how to write programs to use information stored in the cross-reference repository. You can use this information to simplify and automate your conversion process.

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